DOCUMENT RESUME

ED 100 274 HE 006 177

AUTHOR	Stone, Donald C.
TITLE	Professional Education in Public Works/Environmental Engineering and Administration. A Handbook for Establishing University Centers and Programs.
INSTITUTION	American Public Works Association, Chicago, Ill.; National Association of Schools of Public Affairs and Administration, Washington, D.C.
PUB DATE	Sep 74
NOTE	82p.
AVAILABLE FROM	American Public Works Association, 1313 E. 60th Street, Chicago, Illinois 60637 ($5.00)
EDRS PRICE	MF-$0.75 HC Not Available from EDRS. PLUS POSTAGE
DESCRIPTORS	College Role; *Educational Improvement; *Environmental Technicians; *Higher Education; Manpower Needs; Manpower Utilization; *Public Facilities; *Public Service Occupations; Universities

ABSTRACT

This handbook describes various ways universities can make a greater contribution in meeting the country's critical needs for professionally educated public works engineers, technologists, and administrators, and in conducting action-oriented research to improve performance. It is prepared for the guidance of universities, professional societies, government agencies, foundations, and private enterprises interested in creating the necessary education/training and research capabilities. Emphasis is placed on the purpose and scope of public works, public works requirements and the universities, optional arrangements for public works education, program development and implementation, and collaborative relationships and assistance. (MJM)

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Professional Education in Public Works / Environmental Engineering and Administration

A Handbook for
Establishing University Centers and Programs

Prepared by Donald C. Stone for the

AMERICAN PUBLIC WORKS ASSOCIATION
Council on University Programs in Public Works Administration

and the

NATIONAL ASSOCIATION OF SCHOOLS OF
PUBLIC AFFAIRS AND ADMINISTRATION
Committee on Education in Public Works/Environmental Administration

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FOREWORD

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This handbook describes various ways universities can make a greater contribution in meeting the country's critical needs for professionally educated public works engineers, technologists and administrators and in conducting action-oriented research to improve performance. It is prepared for the guidance of universities, professional societies, government agencies, foundations and private enterprises interested in creating the necessary education/training and research capabilities.

Unfortunately no federal "department of public works" exists to sponsor education/training and research for the public works sector, nor is there any national program for public service education which encompasses this vast field. The result is that engineering, technical and other related personnel are appointed and promoted to a great variety of operational, planning and managerial positions without suitable preparation. At all levels of government and in many public and private agencies and enterprises, selections are usually made on the basis of an individual's standing in specialized professional circles or simply because a given individual is on hand. The social costs are enormous. Appointments should be based on education/training and research capabilities so essential in dealing with the great range of policy, program planning, managerial, administrative and operational responsibilities.

The American Public Works Association (APWA) and the National Association of Schools of Public Affairs and Administration (NASPAA) have joined to help redress this situation. APWA created its Education Foundation in 1962 to sponsor short-term training efforts, including a prototype program at the University of Pittsburgh. With feasibility fully demonstrated, the Foundation decided to establish a network of educational centers and, to this end, set up a Council on University Programs in Public Works Administration, headed by Donald C. Stone of the University of Pittsburgh. NASPAA (affiliated with the American Society for Public Administration) also appointed a Committee on Education in Public Works/Environmental Administration. Its chairman is Robert F. Wilcox, Dean of the Graduate School of Public Affairs, University of Colorado.

The effort to stimulate education and research in public works/environmental planning and management has become worldwide. The International Association of Schools and Institutes of Administration (an organ of the International Institute of Administrative Sciences) gave initial attention to this subject at a conference in Rome in 1971 and has since made it a major topic at its meetings in Caracas in 1972 and in Mexico City in 1974. The work papers for these conferences provide the rationale and strategy for accelerated programs in all countries. Copies can be secured from APWA or NASPAA.

An Interamerican Public Works Conference, cosponsored in 1972 by APWA and several international agencies, further crystalized international interest in the need for better trained personnel to plan and implement systems of physical infrastructure and services. The conference resulted in the organization of an Interagency Working Group on Public Works Management which consists of representatives of the United Nations, International Bank

for Reconstruction and Development, Pan American Health Organization/WHO, Organization of American States, Interamerican Development Bank, International Institute of Administrative Sciences, International Labour Organisation and the United States Agency for International Development. The group encourages the creation of national and international training projects, the preparation of guidelines and instructional materials and the expansion of technical assistance to developing countries. An important outcome of its meetings is the proposed United Nations survey of public works organization, administrative problems and training needs. APWA is assisting in these efforts. The 1972 United Nations Conference on Human Environment at Stockholm also contributed to this new widespread interest in public works education by discussions on the side effects of public works on the environment.

The movement to expand and strengthen university programs on public service needs is accelerating in the United States and in many other countries. APWA and NASPAA have planned a number of initiatives to stimulate implementation. They call attention to the resolution on training reproduced as Appendix A. The National Academy of Public Administration (closely allied with the American Society for Public Administration and NASPAA) is similarly engaged in an extensive program of educational improvement under the auspices of its Standing Committee on Education in Public Administration.

The American Society of Civil Engineers has cooperated with APWA and NASPAA in preparation of this handbook. Public works education was featured at the 1974 Conference on Civil Engineering Education, while the American Society for Engineering Education is preparing engineers to respond effectively to technological and social change. Several drafts of this handbook were discussed at meetings of APWA's Council and NASPAA's Committee, and trustees of APWA's Education Foundation and members of NASPAA's Executive Council have reviewed them. Many other knowledgeable persons in and out of government and universities have assisted. It is impossible to list individually the persons who have made valuable contributions, but we are greatly indebted to them and warmly thank them.

Donald C. Stone has written this handbook and incorporated the countless critiques and suggestions. Stone was the first executive director of APWA and of the Public Administration Service, assistant director of the United States Bureau of the Budget and past president of ASPA and NASPAA. While dean of the Graduate School of Public and International Affairs, he organized the Pittsburgh program in public works engineering and administration. He also initiated the Interagency Working Group on Public Works Management. Thus, Stone provides both background and linkages for this cooperative effort.

To Miss Barbara Byers, production editor of the *Public Administration Review*, and to ASPA which made her assistance available to edit the handbook, we express our appreciation.

If professional societies, government agencies, business corporations, foundations and universities will work together to create the necessary educational and research base for this vast and vital field — or group of interrelated fields — our international interests and community life will be

greatly enhanced. To this end we encourage photocopying, circulating, quoting and any other use of the handbook.

Inquiries and suggestions should be addressed to the two associations or to the chairmen of APWA's Council and NASPAA's Committee.

Robert D. Bugher, Executive Director
American Public Works Association

Don M. Blandin, Staff Director
National Association of Schools of
Public Affairs and Administration

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Professional Education for Public Works/ Environmental Engineering and Administration

Part I

PURPOSE AND SCOPE OF PUBLIC WORKS

The purpose of this handbook is to encourage and assist universities in establishing centers or programs to produce the professional personnel and knowledge necessary to execute the nation's public works and related environmental functions. The handbook describes the scope, importance and growth of public works functions; the new kinds of engineers, administrators, program managers and specialists required to cope with rapid technological and social change; the need for action-oriented research; and the manner in which these purposes can be achieved. This includes the means to serve private as well as public enterprise.

The development and utilization of training, research and technology assessment programs are primarily the collective concern of government and private enterprise. Professional and public interest associations are responsible for supportive roles. This handbook is for their use, for universities and colleges and for others concerned with improving public works facilities and services and enhancing urban and regional physical environments.

1. Objectives of university programs

The proposed programs and centers have five interrelated objectives:

(1) To offer pre-service and mid-career professional degree programs for engineers and other personnel to increase their technical competences, but more particularly to provide education/training for such administrative tasks as planning, designing, constructing, operating, maintaining, managing and coordinating the nation's public works and related environmental functions;

(2) To conduct short courses, workshops, institutes and other non-degree training projects to update and increase technical and administrative competences;

(3) To conduct action-oriented technology and administrative research for operational guidance and utilization and for instructional purposes;

(4) To provide expert advisory services to public works organizations, officials and industry; and

(5) To compile and disseminate valuable information to public works agencies and practitioners.

2. Optional arrangements

These objectives can be fulfilled in several ways, depending on the scope of the program undertaken by a university. Five options or alternatives provide universities with specific choices:

(1) An engineering school can reorient its undergraduate and graduate level engineering programs to deal intensively with technology and practice in one or more subfields of the broad public works/environmental sector.

(2) Public works/environmental engineering curricula can be broadened by providing graduate students with more public administration and social science subject matter, including a specialization in public works planning and management.

(3) Paralleling either of these options, engineering students can be given the opportunity of earning a dual or second master's degree or certificate in public affairs/policy/administration, urban planning/management etc., if the university (or an associated university) now offers one or more such degrees.

(4) Another option is to recruit more pre-service engineers and mid-career public works personnel for enrollment in ongoing or strengthened programs in public affairs/policy/administration, urban planning/management or other comparable offerings.

(5) The most needed option is the establishment of some kind of collaborative center — referred to in this handbook as a "graduate center for public works engineering and administration" — through which a school of public affairs/administration and a school of engineering, together with other appropriate units, can combine efforts in specially structured and adapted programs to achieve the above objectives.

The overall aim is to achieve a network of Option (5) centers with a basic public works planning and management component and dual degree or certificate options in every heavily populated or distinctive region in the country. About twenty major centers are envisioned during the next decade. This means that only a few universities or consortia of universities with exceptional resources should undertake the creation of this kind of a center. Appendix E summarizes the program requisites and criteria for a comprehensive center.

3. Scope of public works

In developing an educational and research program, a university must consider the broad scope of public works and determine what functions or subfields it wishes to feature. The American Public Works Association (APWA) defines public works as "The physical structures and facilities that subfields it wishes to feature. The second-generation definition of public works used in American Public Works Association (APWA) circles is "The physical structures and facilities that are developed or acquired by public agencies to house governmental functions and provide water, power, waste disposal, transportation, and similar services to facilitate the achievement of common social and economic objectives."

In developing education and research programs for either broad or limited purposes, the full range of functions or fields of application must be kept in mind. It must be remembered that private corporations and firms such as public utilities, producers of equipment, suppliers of materials and services and consulting firms engaged in public works related functions are equal beneficiaries of university programs.

Public works/environmental functions include:

- Water conservation and pollution control, utilizing dams, reservoirs, aqueducts, pumping plants, treatment and distribution systems to assure the proper quality and quantity of water for homes, farms, institutions and industry

- Wastewater (sewage) collection, treatment, disposal and reuse systems to achieve community health standards
- Air and noise pollution protection to create a more healthful and pleasant environment
- Solid waste collection, processing, reuse, and disposal systems and other community housekeeping activities
- A suitable balance between intercity and intracity highways, railroads, air transport, bus systems and other modes of transit to provide safe and efficient transportation for all categories of citizens (particularly those dependent upon mass transit), goods and materials
- Airports and airway control systems
- Street lighting, street signs and traffic engineering and control to facilitate movement of people and goods
- Power plants, electrical transmission and distribution lines, pipelines and gas mains to meet energy requirements of populated areas
- Flood control, drainage, irrigation and other measures to conserve and reclaim land for productive purposes
- Waterways, marine ports and aids to navigation to facilitate commerce and industry
- Construction of schools, hospitals, libraries, police and fire stations, and other facilities related to planned development and social welfare
- Urban renewal and rehabilitation to renovate and invigorate both the central core and other deteriorated areas of metropolitan communities
- Housing developments and building of new towns to provide homes for expanding populations
- Development and maintenance of parks, playgrounds, stadia and other facilities for recreational and leisure-time activities
- Controls over location of structures, streets and highway appurtenances that serve the community and eliminate sprawl
- Regulation of plumbing, electricity and heating installations to assure safety to occupants
- Land use planning for effective physical development and containment of land speculation in individual communities, metropolitan areas and urban/rural regions, including preservation of green spaces and wilderness areas
- Integration of municipal, metropolitan, state, interstate, national and international facilities and services.

As broad as these classifications may be, they are not all inclusive. For example, space exploration is in many ways a public works program, while major elements of all federal government programs are public works in character. Much of the content of this handbook, while not focused specifically on such functions, are relevant to them.

4. Role and growth of public works

Public works provide the physical infrastructure (facilities and services) essential to urban society and to economic and social development. They constitute the main fabric of what may be called urban physical systems linked to national and regional systems. Public works make human settlements and nations possible. They are indispensable to commerce and industry and to other features of modern corporate life, for they profoundly affect the quality of the environment. Well-planned and well-managed public works must be effectively interlocked with other sectors of public and private

action, integrated execution at local, regional (state), and national levels is essential. For lack of education and research, achievements fall far short of these requisites.

Capital and current expenditures for public works purposes by federal, state and local government in the United States approximate $60 billion annually. Together with defense, welfare and education, this is the largest public outlay; additional billions are likewise invested in similar privately developed and operated systems. Public works expenditures are on the increase everywhere to replace poorly planned and deteriorated structures, services and operations and to meet expanding requirements. The primary cause is the continued pace of urbanization. All over the world as populations proliferate, old and young stream from the land to towns — towns become cities, and cities expand into sprawling metropolises.

These forces are producing new towns, fragmented suburban communities and vast urban complexes; and each is dependent upon a network of physical infrastructure. The kinds of transportation, energy and water systems that are available or projected determine the pattern of land use and development. As one public works director commented, we must be better prepared to respond to "the oncoming rush in the community development field and the way community development will affect our urban areas, both in resources and technological improvement." Structures and facilities designed for a bygone age have become obsolete and must be replaced. The good features of old facilities should be preserved, but both the old and new require coordinated execution adapted to human values and social costs. According to present growth trends, in the next thirty years the United States will need about as much new physical infrastructure as has been provided since colonial times. The bulldozers and concrete mixers are changing the face of our continent — usually to human advantage, but often with serious damage to the environment.

5. Importance of good performance

Effective public works facilities and services are of great significance to every community, region and nation. Therefore, efforts to improve quality, coverage and cost/benefit should be pursued vigorously.

The consequences of poor performance are not sufficiently recognized. For example, inadequate planning of facilities, land use and area development impair the quality of life and generate future slums. Frequently individual structures are well designed, but often they are poorly located for total social use. Pressures from landowners, developers and speculators combined with weak governments and inadequately trained staffs result in overbuilding and overcrowding. The derogation of zoning goals, denudation of terrain, destruction of historical and aesthetic landmarks, and impairment of human values and amenities are evident in both large and small communities.

Powerful lobbies and self-serving politicians sometimes conspire to secure appropriations for projects which are socially undesirable and uneconomical. Deleterious environmental effects are too often ignored. Underestimated costs and overruns are common, while either tight control or loose control often impair performance. In some cases maintenance and operational requirements are overlooked in design and construction, and in many instances the adaptation of new technologies lags far behind. Unbalanced

development and variations in levels of service can be found in communities everywhere.

The single-minded pursuit of one public works objective frequently results in the creation of several other problems (more electric power may lead to thermal and atmospheric pollution, chemical deicing of street pavements to contamination of ground water, over-irrigation to soil depletion, etc.). The public only slightly realizes the limitations of land, minerals and other resources in relation to population growth and increased urbanization. Congress too, in rejecting federal support to states for land use planning, has failed to recognize that land is a public trust and not a man-made product for speculative brokerage. And even less understood are the possibilities of having to curtail some types of public works and certain forms of consumption as the supply of non-removable resources decreases and prices increase. The effect of new technologies, new sources of energy, new developments in other sectors of community and national life, along with the increasing *public* character of private enterprise which performs or supports public works services must also be considered. In the words of a reviewer from the private sector, "The interrelationship of safety, environmental and ecological impact, technological change and material supply may well radicalize our long-standing public works approaches to contract procedures. There will, therefore, be real room for progressive, well-educated engineers to think in terms of the future interrelationship between private enterprise and public works."

Many federal- and state-supported programs have lagged or failed because of poor planning and administration. Inadequacies in time frames, discontinuity in policies and lack of awareness of local realities are especially discernible in some of the federal grant programs. Management and supervision often leave much to be desired, high costs are customary and the policy advisory role of public works leadership in executive and legislative councils generally demands better preparation and expression. These problems arise from a combination of forces – explosive population, scientific and technological developments, social change, human avarice and sluggish government. Revenue sharing will not solve these difficulties; it may only exacerbate them, especially if unaccompanied by long overdue measures to retool and upgrade public administrations at all levels.

6. Inadequate government reaction

Three reasons explain the reluctance of government to respond resourcefully to these forces: first, the procrastination of many government executives and legislative bodies in instituting improved policies, plans, organizational arrangements, administrative processes, management systems and training programs; second, the promotion of imprudent developments by private interests and self-serving politicians and citizen apathy which prevents farsighted solutions; third, the failure of universities to respond to changing educational and research needs. Unless persons are educated to handle the policy and managerial interfaces of these forces and unless research is conducted to provide operational knowledge, the capabilities of public administration will languish. This requires governmental encouragement and support. The federal/state/local system would operate more effectively today and citizens would be more adequately served today if universities had made their contributions during the past twenty-five years.

For these reasons the federal/state/local system is lax in providing infra-

structure and services that correspond to urban social realities. In recent years, the federal government has cooperated with state and municipal associations in seeking new ways to adapt the federal system to technological and social change. But very little was done to encourage modernization of state and local governments. Unless offsetting measures are instituted, federal revenue sharing may become the permanent underwriter of small, fragmented and poorly organized local governments.

In calling attention to these requirements and opportunities and in delineating how universities with the support of government, industry and other groups can provide essential knowledge and human resources, we believe this handbook can contribute importantly to the quality of public service and of life in this country.

7. Terminology

To facilitate understanding of this handbook, the reader should keep several terms in mind. For example, there is no significant distinction between the terms *administration* and *management*. Another term increasingly used to cover the entire gamut of public administration concerns is *administrative management*. These three terms – administration, management and administrative management – are used interchangeably in this publication.

Throughout the handbook, the term *center for public works engineering and administration* is used generically to mean a collaborative enterprise among schools/units in a university (or consortia of universities) featuring a degree program in *public works planning and management*. It includes reciprocal study opportunities (dual degrees) between and among programs in engineering and public affairs/administration and, if relevant, urban planning, architecture, environmental sciences, etc.

Public affairs/administration refers to university schools and programs which engage in professional – as contrasted with disciplinary – education and research at the graduate level. Although such academic units have a variety of labels and differ in scope, they emphasize the development of competences to deal with policy and administration in local, state, national and international environments. Many units have rather limited coverage and capabilities.

In the handbook reference is made only to *universities*. This does not exclude colleges or institutes of technology which may have the resources to implement one of the options, notably (1) and (2). Likewise, no attempt is made to maintain a distinction between the terms *education* and *training*. Recognizing that education is generically a broader term and that some attribute training mainly to skills for manual or narrowly defined jubs, few differences are observable between professional education and professional training – the two widely overlap. Suffice it to say that an educated engineer or public works administrator should be a well-trained person.

PART II

PUBLIC WORKS REQUIREMENTS AND THE UNIVERSITIES

As in other fields of national significance, institutions of higher education can and should contribute to the public works field. Universities are the primary producers of technical, scientific and professional knowledge – both theoretical and applied. They educate and train a diversity of technicians, scientists, administrators and others employed by public works organizations. The main problem is that only limited university effort has been directed to the specific requirements of the public works field. Educational and research programs fall short in quantity and subject matter. Compared to need, very few postgraduate public works engineers and administrators are produced by the universities.

1. New kinds of administrators

Nevertheless, a considerable number of well-trained public works administrators have emerged to fill key posts in federal, state and municipal agencies. An alert person gains managerial competence on the job. He also learns about political, social, financial and administrative matters through reading, professional meetings, visits to other jurisdictions and in-service training opportunities. A few have the benefit of graduate work in public affairs/administration in addition to an engineering degree.

This makeshift method of education is no longer acceptable. The number of engineers who have access to an adequate policy/management/people-oriented education is miniscule in relation to the thousands in administrative positions. To fill this gap, a concurrence of university initiatives (the five options listed in Part I) is envisioned. Through a combination of pre-service and in-service education/training thrusts, public works/engineering skills will be enhanced, and a larger number of persons will be equipped with policy-making, planning, managerial and administrative capabilities.

New administrators should be knowledgeable in social, economic and technological interfaces. They need more sophistication to enable them to work in a complex political environment while serving the total public interest. Commitment to the eradication of discrimination, special privilege and appointments made on factors other than qualification is indispensable and entails administrative sensitivity and resourcefulness in educating and involving citizens and citizen groups. The public works administrator of the future must be an expert public manager in the broadest meaning of the term. Technology must be made the servant, not the overlord, in the development of people-oriented infrastructure and services.

Each of the major fields of public works listed in Part I involves difficult tasks of planning, design, construction, institutional development, resource mobilization, personnel motivation, evaluation, application of changing technologies and public relations. These tasks require an understanding of political, economic and social factors, and above all, a concern for human needs. Consequences and costs beyond those immediately foreseen must be carefully determined and weighed. In the aggregate they call for new levels and kinds of goal setting, policy negotiation, interagency coordination and other sophisticated managerial skills.

The mediating role of the public works administrator is best illustrated

by the controversy over utilizing the National Highway Trust Fund to finance urban mass transit. We see legislators, executives, conservationists, technical experts, manufacturers, lobbyists, automobile associations and government reformers contesting the relative merit of highway investments versus the urgency of providing urban areas with adequate mass transit systems, together with the delicate problem of modifying legislation. The public works leader must be able to analyze the relevant factors in solving urban transportation and urban development problems against the backdrop of present and proposed national transportation strategies and priorities and to recommend solutions which are socially desirable, fiscally feasible, and politically possible.

The engineer-manager in charge of public works/environmental programs whether employed by private enterprise or government – should be qualified to give reliable answers to the questions of *whether* and *when* and *how* public works and environmental protection facilities should be provided or not provided. If this is not done, the $60 billion of public funds spent annually in the United States for public works and environmental control, and the large additional sums expended in the private sector for similar purposes will be insufficiently related to the quality of life and to the balanced development of community and society. This people/policy orientation is crucial, not just in stated purposes, but as a professional commitment to planning and implementation.

2. A new educational strategy

Engineering capability alone is insufficient for these multidimensional purposes. Engineering and other specialized skills must be complemented by public affairs and managerial competences. These include capacity to deal with the gamut of social, economic, environmental and political factors inherent in planning, policy resolution and program implementation. Practitioners are needed who can integrate public works systems and subsystems into urban and national development systems.

Most public works employees now learn about management vicariously and by trial and error. A more effective method of developing public works administrators is sorely needed: a combination of pre-service and in-service training to strengthen and provide a capstone to engineering and other specializations. Training in administration is as imperative for present public works employees as for the education of a new generation to meet future requirements.

Although much of the needed short-term training will be supplied through governmental and professional channels, universities are the only places where professional academic education can be provided. They too should capitalize on spinoff capabilities of academic programs to provide advanced non-degree courses.

In summary, it is urged that the same attention accorded agriculture, health, space exploration, law and business administration be given to education and research in public works/environmental affairs.

3. Administrators, program managers, and specialists

In determining its objectives and course of action, a university should distinguish between three broad categories of professionally trained personnel: (1) professional/technical specialists (2) program managers and (3)

administrative generalists. The differences in knowledge and competences required for these and other categories of public service personnel condition the curriculum as well as governmental practice in respect to position specifications, recruitment and promotion.

Many positions are primarily engineering or technical in character, as for example, design, preparation of specifications and inspection of construction. Senior engineering posts often entail utilization and supervision of specialized engineers and technologists as well as various kinds of para-professionals. Engineers may work individually or as part of an engineering team or unit.

Many engineers in government move into managerial positions. These positions vary. Some are primarily concerned with engineering technology, but most involve program or project management, operations and conduct of services. They occupy both line and staff positions in which tasks of management (see Sec. 6) predominate. The higher the level of managerial responsibility, the less engineering and technical questions can preoccupy their attention, and the more such persons must rely on the skills and judgment of specialists who keep their engineering competences updated.

Large public works organizations also have need of administrative generalists (persons with high administrative management competence) to serve either as top executives or in administrative support positions – such as administrative assistants, budget officers, personnel staff, organization and management improvement advisors, etc. Whether these persons should possess an engineering degree as well as advanced public affairs/administration education will depend on the positions. Persons who have both are critically needed. This underlines the importance of more universities embarking on Options (3), (4) and (5) listed in Part I, Sec. 2. If high quality pre-service or in-service engineers are recruited into such programs, they will move into paramount positions, not only in public works agencies, but also in central executive and managerial posts. Such background, for example, is ideal for city manager, county administrator, state executive posts and deputy and assistant roles.

Graduate programs – both pre-entry and mid-career – should offer these capstone additives. Four-year baccalaureate engineering programs can provide the basic level preparation for engineering, but more advanced education is virtually a necessity for entry into public works fields either in professional practice as an engineer or in administrative responsibilities. This points to a five-year program or a master's degree in engineering or in public works planning and management (public affairs/administration) or preferably in both (Options 3, 4, 5).

4. Manpower requirements

If universities are to respond to this opportunity, they will need information regarding the market for their product. The biggest need is to upgrade persons who have already spent three to twenty-five years in public service. In the absence of any federal office which addresses itself to this national problem, no statistics are available on federal/state/local requirements in subfields or in the aggregate. Obviously the total requirements are considerable.

Some impression of aggregates can be derived from reports of the Bureau of Labor Statistics which show that about 13 million civilians were employed by government in 1972. Of these, the federal government accounted for 2.8

million, with state and local governments utilizing 10.3 million. Federal employment has been relatively stable for some years but state, county and municipal positions show continued increase. These figures exclude what must be one to two million persons employed by privately managed public utilities and corporations providing government type services.

Any rough extrapolation from present manpower estimates and trends points to large numbers of positions that require knowledge of public works technology. Public works and related environmental facilities and services comprise a major part of government budgets, particularly of the states, counties and municipalities. It is estimated that nearly 5 percent of public works employees are in managerial/supervisory responsibilities above second-level supervisors for which education/training in public works/environmental planning and management is needed.

A 1969 study by Kenneth Govaerts concluded on the basis of extensive sampling and analysis that the total number of public works administrators in local government exceeded 15,000. In addition to periodic short-term training and refreshment that all persons require, more than 2,500 lacked sufficient professional education to attain minimum qualification. It is predicted that during the next five years there will be about 6,000 new administrators who should have graduate level training in public works engineering and administration, and in ten years there will be 10,000.

About 150 public works positions were advertised in municipal, engineering and public works journals in 1968. In a 1970 survey, APWA found 818 vacancies in public works engineering positions in 44 percent of the responding municipalities with over 10,000 in population. These same communities reported that they needed 961 additional positions as soon as funds or qualified prospects were available. No information was obtained from counties, but some data was collected from health and highway departments of state governments by Govaerts. He estimates that these two departments alone employed over 12,000 engineering administrators in 1969 and that over 1,000 new administrators would be needed in the next five years.[1]

If a compilation were made of the public works positions in all fields listed in Part I, Sec. 3, for all levels of government (including public corporations, military and civil works) and in all private public works-related enterprises in which administration/management is a significant ingredient, the aggregate would be enormous. Turnover alone opens up large opportunities. Most administrative positions in these agencies are occupied by persons with far less than the desired education/training. A major problem is that most appointing officers do not know what knowledge and competences are needed, nor are they aware of the differences that adequate preparation could make in performance. When a national network of graduate programs becomes established and publicized, professional standards will accelerate rapidly. This is the history of all professional fields.

5. Making managers of engineers

The challenge of adding a managerial *crown* to an engineering and scientific foundation to satisfy managerial manpower requirements is vividly depicted in a study by the National Academy of Public Administration for the National Aeronautics and Space Administration. An excellent summary

[1] Kenneth L. Govaerts, "Evaluation of Public Works Administration Manpower Needs" (master's thesis, University of Pittsburgh, 1969).

and interpretation of this study is issued as Volume I, No. 4, of the *Bureaucrat*.[2] For purposes of planning educational/training programs, this publication has special value in focusing attention on the dimensions of management and the personnel capabilities required of scientists and engineers when they move *off the bench* into supervisory posts and then progress upward to become middle and senior managers.

The study assessed the views of 489 scientist-engineers in both NASA and the National Institute of Health according to levels of managerial responsibility. It found that the management skills required differed between scientists and engineers who function primarily in their specialties with minor managerial responsibilities and those who function as middle level or senior managers. The lower level managerial or supervisory tasks deemed most important were fundamental technology, application of techniques, problem-solving, creative thinking and communication of ideas. For the scientist or engineer who had become a full-scale manager, the most important competences were the ability to (1) operate within the organizational system (2) operate within the financial system (3) operate within the personnel system (4) communicate ideas (5) work with a diversity of people (6) coordinate group effort (7) provide leadership and (8) integrate diverse efforts.

Several tables especially significant to designing curricula identify skills most likely to be a source of difficulty for a scientist or engineer who moves into management. The accompanying table shows the importance which NASA engineers attach to the foregoing competences.

6. Tasks of management

Another way to visualize the managerial responsibility of public works administrators and supervisors is to examine their role in relation to the following schedule of "Tasks of Management." The main categories are:[3]

1. Define objectives and policies for the government, program, enterprise or project (policy planning).
2. Plan programs and resources to carry out these objectives (program and budget planning).
3. Plan and build organization structures and processes to carry out programs and projects.
4. Design and install procedures and operating systems.
5. Procure and manage funds.
6. Mobilize and develop the necessary personnel.
7. Provide the information and accounting systems necessary for management.
8. Analyze, synthesize and communicate the information for the benefit of all concerned.
9. Adjust, guide, coordinate and improve program operations in relation to objectives.
10. Motivate and involve the personnel of the organization in participatory

[2] The *Bureaucrat* was established by the Washington, D.C., Chapter of the American Society for Public Administration. The full report may be purchased from the U.S. Government Printing Office under the title "Transformation of Scientists and Engineers Into Managers" – NASA SP-291 ($1.50).

[3] These are the headings of an analyzed list of tasks initially developed in the U.S. Bureau of the Budget and frequently revised at the Unviersity of Pittsburgh for instructional purposes. Copies can be secured from Donald C. Stone.

processes which fulfill personal and agency objectives.

11. Provide and supervise utilization of plant, equipment, materials and supplies.
12. Establish and maintain external relationships within and without the organization, including the legislature and concerned public groups.
13. Develop and carry out an agencywide system of administrative issuances using consultative processes in their preparation.

SKILLS LIKELY TO BE A SOURCE OF DIFFICULTY FOR A NASA ENGINEER WHO MOVES INTO MANAGEMENT

Skills:	Bench (N=31)	Supervisors (N=49)	Managers (N=51)	Senior Managers (N=30)
Fundamental technology			1%	
Application of techniques	–	–	4	3
Knowledge in related areas	10	4	8	7
Operating within organizational system	26	29	37	37
Operating within financial system	32	24	41	37
Operating within personnel system	36	24	33	23
Recognizing and coping with environmental factors	32	26	35	50
Communication of ideas	10	12	26	17
Working with a diversity of people	42	39	39	50
Coordinating group effort	19	16	22	23
Leadership style	29	24	24	23
Generation of confidence of superior (in employees)	–	–	6	3
Integrative ability	–	8	8	3
Problem solving	–	4	2	–
Decision making	13	16	14	17
Creative thinking	–	2	2	3
None a source of difficulty	–	8	–	3
Depends on man or position he moves into	–	–	2	–

Percentages total more than 100 because of multiple answers.

7. Checklist of knowledge and competences

These managerial skills and tasks can be expressed concretely in terms of specific kinds of knowledge and competences required by engineers, scientists, technicians and others who plan and manage public works facilities and services. Such persons require education/training which enables them to:

- Appreciate the nature of the society, governmental system and working environment in which the public works administrator carries out his responsibilities

- Plan, evaluate and develop public works facilities and services related to other public services and policy objectives and coordinate local, regional and national plans and programs
- Take into account in determining policies, programs and projects the economic, social, legal, political and human factors that condition decisions and the implications of these decisions for the community
- Utilize social science and administrative problem-solving methods in identifying significant problems, isolating key factors and developing and testing alternative solutions; this includes the use of such analytical and evaluative tools as policy analysis, systems analysis, organizational and administrative analysis, cost effectiveness and input-output studies and various operations research methodologies
- Understand the theoretical concepts and operating requisites of administration in both limited and complex organizations and social systems
- Build organizations capable of planning, constructing and operating facilities and services
- Recruit, develop, coordinate, manage and motivate work forces
- Apply advanced management techniques, systems and processes such as program planning, scheduling, network analysis, performance budgeting, management by objectives, administrative feedback, management information and cost reporting, participatory management, etc.
- Negotiate and execute programs and projects, mobilize resources, manage their utilization, assess and apply new technology and methods to increase productivity and evaluate results
- Design bidding procedures, determine qualification of bidders, award contracts, supervise execution and evaluate performance
- Handle labor relations, foster participatory processes, involve minorities and advance social justice
- Maintain effective external relationships — intergovernmental, interagency, political citizen groups, including effective citizen participation
- Acquire expertise in preparing and justifying plans and proposals, technical and administrative reports and other important administrative documents
- Increase technical and substantive competences in one or more subfields of public works/environmental engineering or other cognate fields of practice
- Engage in teaching and research to prepare new generations of talent to apply current concepts and methods and to respond to rapidly changing technologies and social forces

8. Educational implication

Four conclusions of special relevance can be drawn from the study by the National Academy of Public Administration and other investigations of managerial competence:

First, the education/training of engineers and scientists, once they have moved into managerial responsibility, needs to stress the acquisition and maintenance of managerial competences rather than to concentrate on what generally takes place — enhancement of technical skills.

Second, education/training programs should include as a major part of the curriculum the kind of competences identified as essential for effective performance. Instructional methods to develop these operationally oriented

competences require the abandonment of lectures and readings in favor of clinical, problem-solving methods. This calls for the use of actual or simulated policy/organizational/managerial situations and problems as a major part of course effort, with field work where this is feasible. For the inexperienced, it entails internship experience.

Third, a good share of such education/training must take place after the employee has had three to five years of experience and moves into supervisory/managerial responsibilities. This means that university centers and programs should be designed to serve mid-career personnel, and that such persons should be recruited as part-time or full-time students in both academic and non-degree courses. At the same time, it should be recognized that in many jurisdictions low standards of recruitment, political patronage and favoritism have produced public works organizations with many persons who have neither the intellectual or personal qualifications for academic or advanced non-degree learning. Application of the proposals of this handbook will help eliminate such conditions.

Fourth, the analysis suggests that programs confined to policy analysis, administrative science or other curricula which concentrate on quantitative or evaluative methods are primarily suited to turning out specialists for whom the demand is a minute part of the total market. These are important elements of a much broader based form of professional education.

These conclusions complement those derived from the United States Civil Service Commission's analysis of the careers of managers in the federal government, including the route by which engineers, scientists and many other professionals and specialists become managers.[4] Observations of state and local situations also support their validity.

The Comptroller General of the United States recently contacted eight field managers to obtain their assessment of developments in the federal service. He reports that "The need for broad-gauged career executives is greater today than ever before . . . flexible and adaptable to change." They need "a greater variety of experience than their predecessors in agency management, both at headquarters and in the field." He stresses the importance of executive development programs, including better evaluation of the kinds of formalized training programs which have the highest payoff.

9. Responsibility for staff development

In the final analysis, it is the failure of state and local governments and some federal agencies to recognize the value of continuous development of their managerial personnel that is responsible for the scant support outside of the federal service given to train public works engineers, managers and administrative support personnel. If public works departments and enterprises were alert they would have a definite staff development policy and a plan for implementation covering all of their employees. They would also have universities eager to organize training, research and other services to increase administrative capabilities. The American Society for Training and Development reports that private corporations consider employee training vital to corporate survival. Because of its contribution to employee performance and operational achievement, successful corporations spend annually an average of

[4] "Executive Manpower in the Federal Service," United States Civil Service Commission, March 1973.

$250 to $750 per employee on training.

The education/training of managers requires partnership between top management of an agency and its employees as well as between managers at all levels, professional societies and in-house and external training institutions. Any review of the management development policies and programs of cities, counties, states and some federal public works agencies will reveal the meager attention given to such matters in most jurisdictions. Many managers will not even release subordinates for training when it is financed externally. A *progressive* governor recently recalled state employees on educational assignments on the grounds that they could not be spared.

The philosophy, character, importance, organization and techniques of management development in engineering organizations are elaborated in a 1972 publication of the Highway Research Board entitled "Development of Management Capability." This study is of inestimable value to any public works agency or university concerned with the training of managerial personnel. It contains illustrative training courses, coaching techniques, teaching methods and bibliography.[5]

In 1970 the International City Management Association made a survey of in-service training practices of municipalities (Municipal Yearbook, 1971). Of 777 cities responding to the questionnaire, only 5 percent indicated a comprehensive training policy covering all employees. Only 18 percent of the cities responding had any kind of formal administrative regulations covering training activities. Since municipalities interested in training would be the most likely respondents, the conclusion is inevitable that probably less than 2 percent of the local governments of the country have a definitive training policy and a solid program of action to implement it.

10. Importance of research and advisory services

In addition to shortages of trained manpower, big deficits in action-oriented research have accrued. Few public works agencies have identified and publicized the kinds of research they need. Not many have created in-house research capabilities to solve policy, operational, managerial and other administrative problems. Most attention has been given to questions of design, materials, equipment and, increasingly, to new technology.

The National Aeronautical and Space Administration is an outstanding exception. It has not only undertaken in-house research but also has induced a large amount of university research covering a broad spectrum of the physical, biological and social sciences; engineering and other technologies; operating problems; and administration. The Environmental Protection Agency, the Department of Housing and Urban Development and the Department of Transportation do not engage in much in-house research – nor do they give much encouragement to universities, especially in respect to the kinds of substantive and administrative matters featured in this handbook.

As described in Part V, Sec. 11, the National Science Foundation (NSF) is now sponsoring a variety of action-oriented research efforts by universities to solve immediate public problems. It features multidisciplinary efforts applied to technical, operational and administrative needs. Stress is placed on technology identification, adaptation and utilization.

[5] Publication No. 11 in the Synthesis of Highway Practice series of the National Highway Research Program, National Academy of Sciences, 2101 Constitution Avenue, Washington, D.C. 20418

This kind of research and its application to public works organizations is carried out by APWA's Research Foundation. It has engaged in over $2 million worth of research projects financed by interested local governments plus some federal agency contracts. Public Technology, Inc., a non-profit organization created by the International City Management Association and several other public service organizations, is engaged in an ambitious program to facilitate technology utilization by city, county and state governments.

The kind of information, research and guidance most urgently needed are reflected in the knowledge and competences required by public works executives, managers and supervisors as described above in sections 5, 6 and 7. By relating such areas of knowledge and competence to specific public works functions (Part I, Sec. 3), a whole range of fields can be pinpointed in which research is especially urgent, both to develop materials for operational guidance and for instructional purposes.

urgent, both to develop materials for operational guidance and for instructional purposes.

Federal public works agencies, including the Army Corps of Engineers and Navy Civil Works, maintain units responsible for developing improved organization, management and operations; however such in-house resources are not common in state and local departments. The Port Authority of New York and New Jersey is an outstanding exception. Most agencies would have to employ outside consultants to find solutions to complex administrative management difficulties if they wanted expert assistance. Few can secure funds for this purpose. Moreover, there is little published material on public works administration to provide guidance for self-study.

The conclusion is quickly reached that, aside from the new NSF initiatives and the fragmentary grant and contract programs of other federal agencies (see Part V), very little effort is applied today to develop administrative and operational knowledge. Most agency administrative studies and improvement efforts are not recorded, generalized, organized comparatively or made available to other agencies beset with the same problems. Universities have been given meager encouragement and support to perform this natural role. Consequently they have not developed much capability, and the yield of research and its publication is pitifully small. The principal purveyors of information on the application of new concepts and systems of organization, administration and operating practice have been the professional societies such as APWA, ASCE, ASME, ASPA, and the National Academy of Public Administration.

A national strategy or comprehensive program to overcome this deficiency is lacking. No federal office or agency has been charged with providing research leadership and direction for the public works sector or for the entire federal/state/local system. No foundation or group of foundations has collaborated with professional associations and universities in formulating a strategy to fill the void. The end result is the deprivation of public works administrators of access to many kinds of operational and administrative knowledge essential to plan and manage most categories of public works facilities and services.

Fortunately, the need for administrative research and its dissemination is increasingly recognized. Public works officials are urging that more of it be undertaken. What is needed to facilitate both technology and administrative R & D and their utilization is an organized system of coordinate efforts by

undertaken. What is needed to facilitate both technology and administrative R & D and their utilization is an organized system of coordinate efforts by APWA and other professional societies, public works agencies, NSF and other national bodies, universities and public works/engineering/administration journals. Part IV, Secs. 12, 13 and 14, outline the steps a university public works center or program can or should take to organize an administrative research and technology applications program.

11. Causes of university oversight

If the potential contribution of universities is so great, why have they not shown more initiative? The reasons are quite clear. Universities undertake programs in new fields only:

- When university administrators with positive support by faculty leaders or faculty organs conclude that some new endeavor should be initiated and are prepared to utilize scarce resources for this purpose
- When pressed to do so by a convinced group of influential professors, trustees, state legislators or members of professional societies, who are resourceful in enlisting financial assistance
- When foundations or philanthropists provide sufficient monetary inducement
- When government decides some field of education and research is crucial to the public interest and assigns funds and fellowships for its support.

Another obstacle is the rigidity of academic organizations and processes as well as the resistance of most faculties to new programs and curricula which may affect their particular situations. Moreover, public affairs/adminstration is multidisciplinary, that is, it integrates inputs from political science, economics, psychology and other disciplinary sciences along with engineering, public health, law and other social professions. This kind of education is difficult to achieve. Due to a variety of these factors, very few of the proposed comprehensive schools of public affairs/administration have attracted sufficient support to acquire stature. Many have died in gestation.

Establishment of a totally new program encounters these hazards. To have maximum impact, a program in public works planning and management is dependent upon the conjunction on one campus of a school of public affairs/administration with a school of engineering, with university administrators as well as both schools interested in a collaborative effort of this kind.

One or more of the four conditions listed above under which universities undertake new programs has produced great achievements in science, agriculture, health and medicine, space technology, business administration, law and foreign languages. The same kinds of support must now be generated for the major public policy and public service professions, including the public works/environmental sector. Individuals interested in establishing a quality program in this latter area need to be resourceful in bringing about favorable supporting conditions. Any university desiring to play a greater role in public affairs should charge some officer or assistant to the president or chancellor with responsibility for stimulating, coordinating and supporting cooperative efforts.

12. Increasing the response

Increased support for education and research in public works management is beginning to be generated. Leaders in the profession are making their

voices heard; more levels of government are supportive; and public interest and professional associations have become strong advocates. For example, the so-called big six national associations of cities, counties and states have made the training of constituent employees a principal objective. Collectively they have organized the National Training and Development Service to conduct and foster a great variety of training enterprises. The Federal Employees Training Act provides departments and agencies with both policy and procedure in employee training. Recently the Office of Management and Budget has directed all agencies to involve their principal personnel in managerial training. Much of this is, of course, very general.

Creation of the APWA Education Foundation was an early reflection of this new mood. The Foundation sponsors a variety of education and training programs which feature policy, planning and operational, and managerial competences. One of its projects has been the sponsorship of the Graduate Center for Public Works Engineering and Administration at the University of Pittsburgh, which serves as an Option (5) demonstration. The Center is a collaborative enterprise of the Graduate School of Public and International Affairs (GSPIA), the School of Engineering and the Graduate School of Public Health.

At Pittsburgh, a student earns a master's degree in public works (MPW) in the Graduate School of Public and International Affairs and at the same time may work for a second degree in the School of Engineering or the Graduate School of Public Health. Public works students also utilize GSPIA courses in urban planning and management, economic and social development and public administration. Every student working for the MPW must take some work in a field of public works practice. This program has provided a humanizing and participative orientation as well as policy planning and managerial competences for about 100 persons, almost all of whom were experienced public works engineers. They have moved rapidly into responsible administrative posts throughout the United States and overseas. Short-term training projects conducted nationally in cooperation with APWA and locally with the regional APWA Chapter have served far greater numbers.

A dozen other universities have announced new programs, new courses or new curricula, following one of the options listed in Part I. Most of these consist of adding courses in public works engineering, management and the social sciences to an engineering program. Some programs have considerable breadth; other universities are more specialized and feature programs in environmental or transportation engineering, for example. Any program in public works, environmental health, architecture, public administration, public policy, urban planning, municipal management and other public service/public works relevant fields to increase technological and administrative competences warrants encouragement.

An increasing number of engineering schools are starting or strengthening programs in public works, environmental engineering or management of engineering endeavors. Some engineering schools have not only made management courses available to all students, but they have organized departments of industrial or management engineering. While these are usually focused on problems of business and industry, the subject matter is not irrelevant to government administration in general and public works planning and management in particular. A few engineering schools have organized or are proposing programs with a substantial amount of public administration content. Some

of these efforts are collaborative and some are confined to the initiatives of a single school. In this complex field, the technical aspects are generally the easiest to cope with; the public policy, societal, economic and managerial aspects are the most elusive.

PART III

OPTIONAL ARRANGEMENTS FOR PUBLIC WORKS EDUCATION

This part describes the five options or alternative approaches available to a university which desires to create or strengthen education/training, research and service programs in response to the foregoing analysis of requirements and opportunities. Each institution needs to assess its resources and capabilities, analyze its market and develop a plan of action. The potential and requisites of each alternative are discussed in the order in which they are listed in Part I. Option (5), the creation of a collaborative center for public works engineering and administration, is elaborated on at some length because it contains elements related to all other options.

1. Option (1) — Augmenting the substantive component

The simplest way a university can make a greater contribution to the objectives and needs depicted in Part II is to restructure relevant engineering curricula to deal more specifically with public works/environmental functions, particularly at the graduate level. In the absence of government inducements for curricular and research initiatives in public service fields, many civil engineering departments have lagged in adjusting their focus of earlier periods to the challenges of today's urban/industrial/polluted world. Schools, such as public health, architecture, environmental sciences, urban planning and public affairs/administration, also should provide relevant courses in their respective substantive fields.

The purpose of Option (1) is to produce specialists and experts capable of handling difficult professional and technical assignments. Under this option a school may focus broadly on public works or select one or several subfields outlined in Part I, Sec. 3, for intensive development. The following are examples of ways a university may structure its programs by offering specializations or by featuring more public works/environmental substantive content, especially at the graduate level:

- Including a greater public works focus in current curricula
- Developing a public works engineering specialization by a department of civil engineering
- Offering one or more engineering specializations in particular public works fields such as transportation, water resources, environmental pollution control, construction, etc.
- Designing an integrated curriculum drawn from all relevant engineering branches to focus on a major subsector or function, such as energy resources, inter- and intra-city transportation, environmental engineering, etc.
- Strengthening a program in environmental engineering under a school of public health (with linkages to the school of engineering)
- Offering a specialization in urban or environmental design in a school of architecture
- Incorporating substantive and technological elements in a specialization in public works and environmental planning in a school of city planning
- Exposing public administration students to public works engineering requisites and practice.

Any of these approaches calls for some consideration of social, economic, political and other environmental aspects of public works and an appreciation of planning and management elements.[6] Science and technology are not applied in a vacuum. Integration of undergraduate and graduate curricula is desirable, and it provides a means for devoting some attention to public works concerns during the bachelor program.

Option (1) requires the least organizational and curricular changes. In many cases it entails only a modification of objectives, some course revision and greater utilization of courses offered by other departments or schools. If a new integrated program or department is created, the task is more formidable. An experienced program head will usually be needed — one who is capable of leadership in the design of curricula, supervision of research and mobilization of resources. Under any variation of Option (1), the course program should serve experienced students, feature new developments in learning processes and provide contacts with public works practitioners. Fellowships and graduate assistantships are essential.

Illustrations of how university programs have been structured along these lines are readily identifiable. Numerous institutions have established public service-oriented programs in special fields of public works engineering. The two volumes of papers and proceedings of the 1974 ASCE Conference on Civil Engineering Education contain proposals relevant to Option (1) and other options as well.

2. Option (2) — Adding an administrative component

The second option available to a university desiring to make a greater contribution to public works/environmental practice consists of augmenting the Option (1) program with planning and management course work. (See Part IV, Secs. 2 and 3.) At a minimum this can be done by drawing on instructors in other units of the university (public administration, urban planning, business, social science, etc.), or by using external talent or by appointing particularly qualified persons to the faculty. Some utilization of public administration courses from other units in the university or at a neighboring institution is usually possible.

If a program of considerable scope and quality is desired, resourceful efforts will be required in curriculum and course development. The research component should be broadened to include operational and administrative problems. A full-time experienced person with knowledge of operations and administration should head the program. At least one instructor fully capable of handling course work in public works planning and management is essential.

Student recruitment, especially of practitioners for whom the program may be oriented, entails greater effort. Fellowships are vital; special publicity, bulletins and reports to reach public works administrators and prospective students are indispensable. Option (2) calls for a regional service function, linkages with public works agencies and cooperative relations with local chapters of APWA, ASCE, ASPA, etc. Institutions pursuing this option include

[6] Engineering schools interested in strengthening the social science component of their curricula will benefit by examining the innovative and effective arrangements stimulated by the Sloan Foundation. Several schools have received grants to develop and experiment with new courses in which the interfaces between engineering and the social sciences are featured. For information, contact the Foundation at 630 Fifth Ave., New York, New York 10020.

Rensselaer Polytechnic Institute, University of Florida, Texas A & M, University of Missouri (Rolla), Santa Clara, UCLA, and Sherbrook University in Canada.

Both options (1) and (2) are much more easily accomplished than the establishment of a full-fledged center or masters program in public works planning and management. Option (2) will require resourceful effort and development of faculty since most engineering schools lack faculty who are well oriented or technically qualified to offer these new kinds of courses. Much of the discussion under Option (5) and in Part IV is relevant to Option (2).

3. Option (3) – Dual degree and related programs

The third option provides a much higher level of combined technology and management education. It enables a master's student in an Option (1) or (2) type program to secure simultaneously a dual or second degree in a regular master's program in public affairs/policy/administration, urban planning/management or some comparable public administration field. Nearly the same results can be achieved by utilizing a certificate program instead of the second degree. Less credit is involved but the attractiveness of a second degree is lost. The dual degree arrangement has the advantage of enabling the student to earn the degrees in shorter time through an integrated study program than would be required if pursued independently.

At a minimum this type of program entails all of the developmental efforts, organizational adjustments and other requisites of Option (2) plus some kind of formal consultative process or joint sponsorship. It calls for continuing collaboration by the sponsoring parties and authentication by a chief academic officer or organ of the university.

The dual degree option could be offered merely by modifying course requirements so that each school will recognize considerable work pursued by the student in the other school. (See Part IV, Sec. 4, on the design of programs.) However, some redesign of the administrative component is very desirable. Later sections describe how this and other elements of a viable program may be implemented. A cooperatively planned dual degree program may in fact be a stage in moving toward an Option (5) arrangement.

The public affairs school offering the second degree will need to designate a program director to see that these developmental and operational tasks are carried out. The heads of the dual degree programs may function as a committee of co-directors and be responsible for keeping the deans of the schools and the central academic officer up-to-date.

If a dual degree study or a certificate arrangement is not feasible, schools of engineering and public affairs/administration (and other units) can identify or initiate courses of value to each other's students. A number of engineering schools have encouraged students to elect courses in schools of public affairs/urban planning, etc., and vice versa. The more such opportunitites are formally planned and promoted, the greater the possibility of an effective outcome.

Several universitites have sponsored combined degree and certificate programs, notably the universities of Cincinnati, Southern California and Michigan. Cincinnati pioneered with this idea in 1927-1928 as a part of the cooperative system of education. Civil engineering students were given the option (leading to a certificate) of enrolling in courses in municipal govern-

ment, public utilities, personnel administration, city planning, public finance and public works administration. USC's School of Public Administration initiated dual degree and certificate programs in several engineering fields beginning in 1929. By 1938 at the University of Michigan, the Institute of Public Administration and the College of Engineering jointly offered the degree of Master of Engineering and Public Administration.

These early approaches are now being formalized at other institutions. For example, Ohio State has established a dual degree program which is cosponsored by the School of Engineering and the Division of Public Administration.

4. Option (4) – Enrollment in public affairs/administration

The fourth alternative has been utilized to some extent for many years by schools of public affairs/administration and urban planning. In its simplest form it features the enrollment of graduate engineers in regular degree programs and short-term courses. To achieve the objectives of this handbook, such a policy should be reflected as an organized program in public works. This calls for many of the same steps including: (1) establishment of cooperative links with local and regional organizations (2) formalization and publication of the program (3) offering of special measures, including fellowships, to enroll capable engineering graduates, especially mid-career persons (4) orientation of some course work and informal activities to the problems and interest of public works practitioners and (5) encouragement of students to utilize courses in engineering, public health, environmental sciences, urban planning, etc., as interests and needs indicate. A knowledgeable faculty member should head the program and be responsible for seeing that the total effort is well organized and implemented.

The School of Public and Environmental Affairs at Indiana University is pursuing this approach, including the establishment of cooperative links with other units and universities. If a school develops a curriculum in public works/environmental planning and management as described below and achieves good cooperation with engineering and other units, it can gain many of the advantages of an Option (5) center. However, a student will not secure the advanced competences in public works/environmental engineering, public health engineering, environmental sciences, etc., that are provided by the dual degree in these fields under Option (3) and which is also recommended under Option (5).

The first training program in public works administration was established in 1915 as a part of the first full-time public administration school, the Training School for Public Service, in New York. The School was associated with the New York Bureau of Municipal Research and later combined with it to form what is now the Institute of Public Administration. For several years one of the seven optional fields of specialization for public administration students was municipal engineering and highway administration.

5. Option (5) – A collaborative center

The key characteristics of a comprehensive center of public works/environmental engineering and administration are:

A. Collaborative planning and implementation of graduate education, nondegree research, and service programs by a school of public affairs/administration, a school of engineering and to whatever extent relevant

such additional units as public health, urban planning, architecture, environmental sciences, etc.

B. Initiation of a specially designed master's degree program in public works/environmental planning and management (however titled) as the basic element, normally to be the academic responsibility of the school of public affairs/administration.

C. Dual degree or certificate opportunities whereby a student enrolled in the basic master's program may pursue simultaneously a master's degree or certificate degree in engineering, public health, architecture, urban planning or environmental sciences.

D. A commitment to non-degree in-service training, research and public services.

E. Establishment of a collaborative entity designated as a center or institute through which these inputs are planned and coordinated, functioning either under the supervision of a general academic officer of a university or under a director within a comprehensive school of public affairs/administration, with which other university units freely join in cooperative planning and execution.

An effective school of public affairs/administration is a primary unit in a collaborative center. Equally essential as a primary root source in establishing such a center is the ready availability of a school of engineering with a practice-oriented (rather than science-oriented) curriculum.

Other root sources can contribute strength: (1) a school of public health with an environmental health engineering component (2) a school of urban planning — if not a component of the school of public affairs – and (3) a school of architecture related to urban design, facility and functional planning and construction. Schools of business, environmental sciences and medicine may also make useful inputs.

The key to success in establishing a collaborative center for public works/environmental engineering and administration (or any other interprofessional and interdisciplinary enterprise of this character) is the desire of the participating elements to work together. At a minimum, this means the wholehearted commitment of a school of engineering and a school of public affairs/administration to pool efforts and create a new organism. Beyond this, it calls for collaboration between such academic entities as public health, urban planning (if separate from public affairs), architecture, medicine, environmental sciences or any other unit having relevant interests and capabilities. Also there must be university leadership that is interested in collaborative endeavor and willing to spend the time to achieve it. This cooperation may and should include other universities in the region. Few universities have all of the necessary elements for a strong program.

A guide published by NASPAA entitled "The Response of Higher Education to the Administrative Needs of the Public Service" stresses the need for joint and collaborative effort among two or more schools in most public service education and research fields. As a first of several examples it lists:

Public works planning, engineering and administration in one or more constituent fields such as:

- public transportation
- urban mass transit
- water resources and supply
- water pollution control and disposal of liquid wastes

- solid waste disposal
- air and noise pollution control
- construction and operations.

The guide points out that:

Unless a school or center of public affairs/administration is pivotal in developing collaborative or joint programs, the product usually will lack the input essential to integrate disparate elements and to achieve operational and institutional capability. Administration, particularly planning, policy resolution, development of delivery systems and management are crucial; but all too often they are missing ingredients.

There is a further reason for joint and collaborative programs involving schools or centers of public affairs/administration. This is readily apparent in such specific and interrelated fields of public action as public works, social welfare, health, education, community development, model cities, urban planning, recreation and law enforcement. Policy and program administrators in these fields need to share a considerable body of knowledge and possess many similar competences. Not only must such functional or sectoral elements be welded within individual municipal, state and federal governments, but they must be integrated within metropolitan areas and coordinated between levels of government.

Whatever the scope of public works/environmental functions selected for primary attention, any center serving the public works sector should be grounded in a strong graduate academic program with dual degree options. The curriculum and teaching should be oriented to experienced personnel (which will also make it relevant to recent graduates). The academic program should be supplemented by organized arrangements for non-degree training of mid-career practitioners, action-oriented research and publications programs and commitments to provide advisory services to public works agencies. It should serve as a clearing house of information and a wellspring for the improvement of public works practice and professional cooperation within the region served by the institution.

The core element of a center is a master's program focused on public works/environmental planning and management which leads either to a master of public works (MPW) degree (as recommended by APWA), or to a master of public works administration, or to a master of public affairs or public administration (MPA) or to a similar professional degree.

Academic programs normally will be limited to curricula leading to master's degrees. Hopefully a few universities with strong graduate professional schools and sufficient resources will initiate doctoral programs to produce faculty members, researchers and mobile administrators. Instructors with relevant educational preparation are presently almost nonexistent. Therefore, most doctoral students should have five to ten years of operational experience.

6. Organizational arrangements for Option (5)

A simple and effective administrative structure is not easily achieved. The plan evolved at the University of Pittsburgh provides one model. The Graduate Center for Public Works Engineering and Administration is a formally established partnership of the schools of Engineering, Public Health (GSPH) and Public and International Affairs (GSPIA). It functions under the

general responsibility of the provost and three deans who comprise a policy board under the provost. A subordinate committee or working group of faculty from the three schools consult on curriculum, requirements, recruitment, admissions, research and publicity. The Center is a coordinating development instrument, not an academic entity.

The basic degree, Master of Public Works, is offered by GSPIA which established a Department of Public Works Administration for this purpose. The head of the Public Works Administration program also serves as director of the Center. In the latter capacity he is responsible for keeping the three deans and provost informed of developments; for monitoring inter-school working groups; and for providing leadership for promotional efforts, student recruitment and admissions, relationships with agencies and cooperative research service projects.

Variations from this model will be required to fit each situation. Inasmuch as the basic degree in public works planning and management (however titled) will need to be granted by a school of public affairs/administration, that unit must at least be an equal partner. If the center conducts a substantial research program or has major responsibilities for supervising academic programs, a different person acceptable to all three schools may be desirable. Joint appointment in the cooperating schools might be advantageous.

If no central university officer is prepared to accept special responsibility for the center, administrative and financial accountability can be obtained by making the director or coordinator of the center administratively responsible to the dean of the school of public affairs/administration. This is a preferable solution, since many of the difficult policy and program issues focus on academic and non-degree training aspects of the curriculum in public works planning and management.

Whatever the plan, it should be formalized and published as a visible entity. Under any arrangement the heads of the schools or units concerned should comprise a consultative policy group (without administrative responsibility). Unless the program is fostered and sustained by a chief university officer, it is likely to disintegrate with changes in personnel.

Appendix E provides in capsule form a summary of program requisites and criteria for Option (5) collaborative centers.

7. Source of the public affairs/administration component

The knowledge and competences required by public works/environmental administrators outlined in Part II illustrate vividly the reason a full-scale public works center or a master's program in planning and management should have a taproot in a school of public affairs/administration. In the absence of such a school, the architects of a public works curriculum will be hard pressed to assemble the components for a creditable enterprise. Unfortunately, there are not many comprehensive schools of public affairs/administration (about 20), and most of these have not been adequately financed. However, the number is growing and more limited programs, often of considerable merit, are multiplying.

If a comprehensive school of public affairs/administration with the above objectives does not exist, are there other resources that can be drawn on for structuring an Option (5) center or for the planning and management component of other options? Possibly, if the university sponsors programs of some

quality in public administration, public policy studies, urban affairs, urban and regional planning or business administration.

Strong public policy-oriented social science faculties — notably economics, political science, sociology and psychology — have much to offer. They may already teach or be able to design cognate courses of considerable merit. They are a source of analytical expertise. However, reliance on social science departments to provide the all-important professional/administrative component is not a viable solution in creating a comprehensive center or the administrative component of any option.

The purpose of professional education is to develop in its graduates insights and skills to mobilize, adapt and apply knowledge from all relevant disciplines and other professions. The object is to achieve policy and program (operational) objectives and to effect change through action. It is problem and practice oriented with a major clinical component. A good public affairs/administration program does this, drawing on and maintaining linkages with the social sciences.

In the absence of a school of public affairs/administration is it feasible to base a public works center in a school of business or to utilize its resources for the planning and management component? It can be argued that course work on organization, management and analytical tools is relevant and that some public works enterprises have business characteristics. While some of these subjects are pertinent, the policy issues, values, political factors and environmental orientation of a school of business are fundamentally different from public administration. It is the latter's preoccupation with the policy, fiscal, institutional and functional elements and processes in the public sector which makes grounding in a school of public affairs/administration the only really satisfactory solution.

Is it feasible for a university with exceptional engineering resources to combine efforts with a school of public affairs/administration of a conveniently accessible institution? This is a good possibility, but the result will inevitably be a more limited or specialized program.

These variables all point to the differences in the structures, programs, strengths and centers of leadership in different institutions. A university may prefer to pursue these objectives by creating a new collaborative center with curricular responsibility, or by expanding its school of public affairs/administration to tie the elements together or by broadening a school of engineering to enable it to offer a management program free from traditional engineering requirements. It is also possible that it may settle for one of the other options.

PART IV

PROGRAM DEVELOPMENT AND IMPLEMENTATION

The decision about the option to be pursued is but one of many steps required to plan and implement a program. Curriculum design, course organization, faculty development, student services, continuing education, research, professional relations and mobilization of financial resources also entail individual and collaborative effort.

1. Design of curriculum

In developing a comprehensive public works curriculum, four kinds of course inputs should be considered:

(1) The technology/substantive element — the engineering, environmental health, environmental science courses

(2) The core course requirements of the public works planning and management program

(3) Elective public affairs/administration courses (including urban planning and management) designed to serve public works students

(4) Electives of a cognate character in fields such as business administration, accounting, quantitative analytical methods, public finance, economic development, political science, etc.

Each of the options described in Part III requires continuous updating to reflect advances in science and technology and changes in professional practice. This involves the development of new courses, the discontinuance of old ones and the readjustment of others to meet (a) the needs of dual degree and certificate students and (b) the increasing number of regular engineering students who wish to develop greater competence in a public works subfield or function, e.g. mass transit, water supply, environmental pollution control, construction, etc. This is part of the task of developing effective clusters of courses in general aspects of public works practices as well as in subfields which the engineering school (or other unit) desires to feature.

The conferences and publications of the American Society of Civil Engineers, the American Society for Engineering Education and other professional bodies provide guidance in developing this element.

For purposes of this handbook the principal problem is developing the planning and management component under any of the optional arrangements, ranging from the addition of two or three courses under Option (1) to a formalized master's program in public works planning and management under Option (4) or (5).

By defining tasks of management and outlining the knowledge and competences which public works managers utilize, Part II, Secs. 5 and 6, supply building blocks for the planning and management curriculum. The job is one of selecting priority subjects and designing courses.

2. NASPAA's matrix of professional competences

Authoritative guidance is now available for designing the core or basic course component for a public affairs/administration curriculum. NASPAA's recently adapted "Guidelines and Standards for Professional Master's Degree Programs in Public Affairs/Public Administration" should be utilized by every institution initiating or strengthening course work in public works planning and management. (See Bibliography, Appendix B.) The recommended matrix

of professional competences to be acquired by all graduates has two parts. Part I presents subject matter areas under five headings:

(1) Political-Social-Economic Context
(2) Analytical Tools: Quantitative and Non-quantitative
(3) Individual/Group/Organizational Dynamics
(4) Policy Analysis
(5) Administrative/Management Processes

Part II of the matrix shows program specializations under two headings:

(1) Level of Government
(2) Public Function — of which Public Works Administration is one of fourteen illustrative fields. Two others are wholly or partly encompassed by public works: transportation and environmental administration.

3. Planning and management courses

Using the above matrix and the specific competences described in Part II as a guide, clusters of courses can be designed which cover the basic or required part of the planning and management program. For this purpose the administrative/management part of the matrix is a most important element. These core courses should be professional or operational in character. Their purpose is to develop immediately usable on-the-job skills as well as the theoretical or conceptual framework for more advanced courses and for career development.

If the university is endowed with a good school or department of public affairs/administration, it should cover the matrix subjects to a considerable, if not exceptional, extent. The objective is to enroll a sufficient number of engineers and others concerned with public works to warrant the development of a curriculum which features public works/environmental applications.

Whether forged out of an existing master's curriculum or developed *de novo*, a public works planning and management program will require four to six core courses. An illustration is the Pittsburgh master's program in Public Works Administration. The following courses are required of all students:

Public Management: Theory and Practice (a more advanced executive management course may be substituted if background of student warrants)
Public Works Management I
Public Works Management II
Research Methodology-Statistics (a more advanced course may be substituted)
Systems Analysis in Public Works Management

These courses, plus electives, cover most of the subjects in NASPAA's curriculum matrix. Appendix C shows the subject matter covered in adaptations of Public Works Management I and II for foreign and United States students interested in public works in other countries.

Another question to be resolved is determination of the balance of course work between engineering or technology and planning and management. In an Option (4) or (5) master's program in public works management the engineering/technology portion should not exceed one quarter of the degree requirements. In an Option (1) program the engineering component might constitute three quarters of the course work. In Option (2) the ratio might be one half to two thirds. The ideal way to develop graduates with high competence in a special field of practice as well as in planning and management is to

provide simultaneous pursuit of a dual or second degree (or certificate), i.e. Options (3) and (5).

A dimension heretofore widely overlooked in administration and engineering courses should be reflected in any public works curriculum. This is the proliferating side effect of public works on water, air, land and life. Preoccupation with a narrowly conceived public works project may have serious second-, third- and even fourth-level consequences. Public works engineers should be taught to look beyond immediate technical solutions to their environmental implications and to learn how to identify, analyze and minimize them. This is part of the total public works cosmology in which policy planning and management must respond to the interacting effects of population growth, urbanization, technology, resources and ecology on quality of life. The report of the United Nations Conference on the Human Environment (Stockholm) presents public works planners, policy makers and managers with a staggering agenda for implementation.

4. Designing dual degree and certificate options

Although a combination of degree and certificate programs were initiated by schools of engineering and public administration in the 1920s, recent growth has been slow. With a tapering off of university enrollments and a concurrent financial squeeze, there should now be greater interest in collaborative efforts and pooling of resources.

Dual degree and certificate programs require breaking down traditional academic barriers and rigidities. For a viable dual degree plan, there must be mutual recognition of the value and applicability of courses taught in other schools, departments or universities. Pittsburgh's program provides an illustration. For the Master of Public Works degree offered by the Graduate School of Public and International Affairs, the minimum requirements (36 total credits) are: five public works administration courses, two approved electives in administration, two electives in a field of practice, thesis or research report and an oral examination.

Concurrently, the student can pursue a master's degree in the School of Engineering or in the Graduate School of Public Health. These two schools recognize up to four courses (12 credits) in public works administration as meeting their degree requirements. A single thesis or research report satisfies both degrees, if it is of sufficient breadth in administration and engineering or environmental health. Through this integrated curriculum a student can complete both degrees in four trimesters (16 months), i.e. two academic years of work. Often completion of the research/thesis takes somewhat longer. Students not in dual degree programs are encouraged to take more than the minimal course work in other schools when it is advantageous to their programs.

Dual degree opportunities can well extend to other areas – urban and regional planning, environmental sciences, architecture, etc. The great advantage of the dual degree opportunity for a public works planning and management student is the increased competence it provides in the technology and practice in a subfield or in a cognate field of public works. At Pittsburgh the following subfields are specified for both the single and dual degree student in public works administration:

- Urban Transportation Planning, Engineering and Administration (Engineering)
- Urban Planning, Development and Management (GSPIA)

- Water Resources Engineering and Planning (Engineering and Public Health)
- Environmental Health Engineering and Planning (Engineering and Public Health)
- Economic and Social Development — features developing countries (GSPIA)
- Advanced Civil Engineering Technology — oriented to public works practice (Engineering)

Other universities will have resources which enable them to offer different subfields or specializations such as public works construction; environmental planning and pollution control; conservation; oceanography; energy planning, engineering and management, etc.

Development of viable dual degree and certificate programs requires intensive curricular work, formalization of the plan, commitment of resources, publicity, student advisement, faculty cooperation, and encouragement by university officers. Some of the benefits of dual degrees can be achieved through recognition of the value of course work offered in another school rather than in the one in which the degree is earned, provision of service courses by one school for another and joint planning of degree programs to serve multiple interests.

5. Providing the clinical element

Professional education as recommended under all options requires contact with the real world — its problems, environment, successes and failures. Mid-career students bring experience with them which can be exploited in instructional methods and informal contacts. Pre-service students can learn much from them through discussions and collaboration in clinical exercises.

Case problems, simulated projects, role-playing, field work, the syndicate system and other practice-oriented tasks can give the student in a highly intensive and telescoped manner as much experience (and often much more) as he would gain through an internship or regular employment. Whether this can be accomplished as a curricular by-product will depend on the background and resourcefulness of the instructors. However, there is no substitute for an inexperienced person being immersed in an operating organization. Clinical assignments, internships or initial employment that expose him to various agency operations have much value.

This leads to the question of whether an internship or thesis should be a degree requirement. A typical library-based thesis on some limited subject or a synthesis of what others have written is not recommended. Better alternatives are available to provide a capstone analysis or synthesizing experience. For a student with limited public works experience, a supervised internship is often desirable. He could also prepare a written analysis of some aspect of the experience and/or be examined orally.

For the experienced person, a problem-solving study resulting in a project report is recommended. The purpose of the report is to develop analytical and operational competences in relation to the kinds of problems or tasks the student will encounter on the job. If an inexperienced student engages in this kind of research, he would be well advised to select a problem entailing empirical research in one or more agencies. Since the research report of an experienced person is subject to fewer restraints, it should make a contribution to the field. If a center engages in contract research and advisory assist-

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ance, these projects will provide inviting opportunities for practical experience on a remunerative basis. Assignments to fulfill an institutional obligation which provide no significant learning experience should be avoided. In the case of dual degree programs, it is feasible and desirable to select a single project which covers the substantive concerns of both. The report or thesis must then be satisfactory to an examining committee representative of both.

6. Development of faculty

Next to obtaining adequate resources, the most decisive task in organizing a center or program is the recruitment of head and staff. Since doctoral programs in public administration are rare and those serving the field of public works administration are as yet only in the incubation stage, it is essential to find persons — mostly engineers — with suitable experience and professional degrees in public administration, urban planning and management or some other relevant combination of education and experience.

The importance of practical experience is emphasized in the proposed new ASCE policy statement on engineering education which says:

> To lead this educational process, a majority of the faculty of civil engineering schools should be themselves successful practitioners, capable of instilling into the minds of their students a wholesome respect for their chosen profession and of inspiring in them a genuine love and enthusiasm for their work.

The United States Civil Service Commission reports that a Government Affairs Faculty Fellowship Program will be established to encourage the placing of college and university faculty members in federal agencies for meaningful work experiences to complement their teaching and research interests.

Doctors in public administration, especially when subsidiary to political science departments, generally have few of the managerial and operational competences required of an administrator. Many curricula are either primarily social science in character or preoccupied with analytical methods, abstract theory, behavioral science or special processes or techniques. This is best explained by the tendency of professors to produce students in their own image — students who are knowledgeable about the matters with which their professors have been concerned in their own educational and teaching experiences. Since relatively few faculty members in schools and centers of public administration have had substantial managerial education or experience, there is now an acute shortage of faculty capable of handling the required managerial competences outlined in Part II, Secs. 7, 8 and 9. This is a reason why doctoral fellowships are exceedingly urgent — to prepare experienced administrators for teaching posts.

In staffing a public works center, it is preferable to compromise on the question of a Ph.D. rather than on the instructor's knowledge and competence in program subject matter. As in other new fields, the highest applicable professional degree should be qualifying — which means a combined engineering (environmental health)/administration preparation. A considerable number of engineers have engaged in relevant master's and doctoral study: the task is to find them. At Pittsburgh, some students earning a single or dual degree in the program in public works engineering and administration are also earning Ph.D's with majors in public administration, urban affairs or economic and social development, with their minor and policy fields in public works/environmental affairs. Another possibility is for a person with a Ph.D.

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to pursue a master's or special program in public works planning and management. An especially attractive alternative to temporarily buttress the faculty with an experienced public works administrator is to request a *mobility assignment* under the Intergovernmental Personnel Act. (See Part V, Sec. 6.)

Some universities are retreading engineering and public affairs faculty members by assigning them elsewhere for advanced preparation in the new subject matter. In early years, considerable reliance may be placed on practitioners who have good academic backgrounds and a competency in teaching, but who often need guidance in teaching methods, in teaching materials and in the use of visual aids. To be avoided is the person who merely lectures on how "fish are fried in Oshkosh" or engages in anecdotal or descriptive narrative.

This points up the need for the establishment of doctoral programs to prepare instructors, researchers and mobile policy/administrative personnel in public works/environmental planning and management. A suggested interim measure is the conduct of a short-term institute by APWA/NASPAA with the assistance of the National Training and Development Service to improve public works administration teaching methods, materials and skills.

A high ratio of faculty to students is required at the outset. This is due to (1) the innovative character of the course work (2) the lack of teaching material (3) the high public service demands on faculty time (4) the time-consuming supervision of student projects, field work and internships and (5) the extensive efforts to secure grant and contract funds for fellowships, instruction, library and research. The use of *ad hoc* or adjunct appointments and lecturers can help raise the ratio.

7. **Recruitment of students**

Resourceful and sustained recruitment of students will require much staff effort. This applies equally to the assignment of mid-career employees by government and private agencies and to the processing of applications from students who wish to continue their studies. The current reorientation of engineering schools to public service and to public works should make this easier to do in the future.

Simultaneously, strong representations are needed to induce government agencies, public utilities, corporations and consulting firms to assign students. Public officials, especially at municipal and state levels, must be sold on the importance of in-service education and induced to secure budgetary authority for staff development. Released time and coverage of at least some of the tuition for employees who engage in part-time professional study to improve job performance should also be arranged.

Since few public works employees have been trained in administrative/managerial competences, a majority of the students may appropriately be persons already in public or private employment. (Part II, Secs. 5, 6, and 7, provide the rationale.) They may engage either in full-time study under sponsorship or leaves of absence or in part-time study with or without agency support. Released part-time study or grant-supported sabbaticals appear suitable to upgrade the personnel of municipal, county, state and federal programs in metropolitan areas.

Fellowships, assistantships, research stipends, work-study arrangements or other forms of financial aid are indispensable in initiating a public works educational program. Thus, paralleling measures to stimulate applications, the institution should engage in vigorous promotion and negotiation to develop a

continuous flow of sponsored full-time mid-career students, agency support for part-timers and fellowships, and other financial assistance for recent graduates (especially minority persons) and for employees of public agencies which are unable to provide financial support. An informative and readable bulletin or brochure is indispensable both for recruiting students and for explaining the program to persons whose support is desired.

8 Admission and scheduling

The public works center or the school which carries out the master of public works program should have authority to set qualification standards and admit students. While most students will be engineers who hold engineering, environmental health or architectural degrees, some may be physical, biological and social scientists concerned with environmental and technical matters, urban planners and developers, and public administrators.

Admission requirements ordinarily applied to arts and science students are not relevant. Applicants who have had several years of experience should be evaluated on the basis of their past performance and demonstrated competence. This requires telephone inquiries to former supervisors and instructors, interviews and other tested means of appraisal. Undergraduate records or application of the Graduate Record Examination may not have any significance. This is especially true of minority, overseas and mid-career students. The aim should be to admit persons with solid intellectual resources, outstanding personal qualities contributory to professional leadership and achievement, and high commitment to public service.

A sufficient number of students should be admitted to the public works planning and management program to make an impact and to support the specially designed courses. This requires at least twelve to fifteen full-time students plus enrollment of a sizable number of full-time employees in part-time study. It is important to enroll students from public affairs/administration programs and other professional schools in these courses to bring into the classroom the diversity of backgrounds and viewpoints which the public works practitioner encounters in managerial positions. To achieve a rewarding experience for both mid-career students and recent graduates, the number of mid-career students in any course should predominate.

Part-time study opportunities for persons already in public or private work may be provided through admission to regularly scheduled courses for full-time students; specially scheduled courses early in the mornings, evenings or on Saturdays; or concentrated sessions on weekends or for several day periods. Off-campus special package arrangements to serve groups of practitioners in urban centers are also advantageous.

A suitable requirement for completion of a master's degree is the equivalent of a year of full-time study. In academic terms this means two semesters plus a summer program, three trimesters or four quarters. This may include an internship or a research field work project adjusted to the needs of the student. This would comprise thirty to thirty-six graduate credits, assuming a full course load is twelve hours. Such work need not be full-time or continuous. It may be part-time, intermittent full-time, off campus, or in concentrated periods for several subjects or a single subject. Flexible arrangements to serve public works practitioners are encouraged. If a student's engineering education is unrelated to public works, or if it is deficient in social science analytical processes, or if it lacks relevant experience, a longer period of

course work may be required. Correspondingly, individuals who have already completed graduate course work or who have had especially beneficial experience may be granted some advanced standing.

An integrated dual degree program in which the student earns a master's in public works planning and management and simultaneously a master's in engineering, environmental health, urban planning, etc. will require an additional term or possibly more, but total time should be less than if each degree were pursued independently. The way in which this is accomplished at Pittsburgh is described above in Sec. 4.

9. Short courses for experienced personnel

Since most of the educational preparation of engineers and other specialists for administrative responsibilities will of necessity take place after they have moved into the supervisory/managerial stream, a diversity of short-term courses, workshops and seminars are needed. These may be of several types: one or two days full-time; a week, two-week or month residential seminar; one night a week for ten or twelve weeks; etc. Short courses are equally necessary to update engineering technology and practice.

Governments, consortia of governments, professional and public interest associations, community colleges and technical institutes will cover most of the public works in-service training requirements. However, a university can make a distinctive contribution for advanced work both in substantive/technology and administrative fields. For this reason, every public works center must respond to the need. The demand by public works agencies for university short courses should be large. However, more city, county and state agencies must institute effective staff development policies as recommended under Part II, Sec. 9. They must also be persuaded to pay the cost and to release employees for the required periods.

Recognition of the value of in-service training is unfortunately marred by the low quality of some training courses. Executive development and management courses have often been flimsy. The temptation – probably because of inadequate funding – is to schedule a series of lectures on appealing topics and follow it by a discussion period. In such a case, the public works man usually finds himself in a group of persons with dissimilar interests. Presentations often focus on management techniques, planning, programming, finance, personnel, decision making and quantitative methods – without relating a word to public works. Why? The instructor is either only a theorist or is unfamiliar with the field. Even if well taught, most of this kind of training is unsatisfactory unless it is designed for public works practitioners and features clinical elements.

APWA is creating a better climate, both by its advocacy of agency commitment to training (Appendix A is illustrative) and by its own national program of management seminars, workshops and clinics. Although very successful, it is obvious that APWA's courses deal only with a fraction of desirable subjects and cover only a small part of the potential market. But they provide experience which a university faculty should draw upon when developing its program. In turn, universities can help plan and conduct APWA training projects.

10. Design of short courses

Determination of the content, method and arrangements for a non-degree

program requires even more rigorous R & D than an academic course does. So much has to be accomplished in a short time, including involvement of participants in problem solving and other experiences to increase their capability. Literally, the outcome of every minute of the course has to be anticipated.

Appendix D contains three examples of short courses or seminars for public works officials. The scope and combination of important subjects are almost limitless. Each course should be designed specifically to enhance the most critically needed competences of the participants involved. The tasks of management and checklist of knowledge and competencies in Part II, Secs. 6 and 7, provide a pool of subjects to draw on in designing short courses, just as they contribute to an academic curriculum. Appendices C and D also contain suggestions.

The closer employees are to actual operations the more the subject matter must embody the substance or technology of the particular kind of public works for which they are responsible. Conversely, for middle and higher level positions and for young persons who are dealing with the interfaces of one subsector with another or with wider aspects than the supervision of particular work operations, the curriculum should focus on broad administrative/policy/social aspects. There is an advantage of having personnel responsible for different kinds of public work facilities and services at local, state and federal levels interacting in the same educational programs. In supplementing programs focused on higher level managerial competences, all supervisors should be trained in ways to upgrade the skills of their employees.

Reliance on lectures, descriptive material, precepts or absorbing information have little place in professional education and are to be avoided in short courses for experienced personnel. Rather, inductive methods utilizing problem-solving simulation, cases, syndicates, role playing and other exercises based on tasks which the public works engineer and manager must perform in his world are recommended. It is also important that participants work hard and be given rigorous tasks to perform outside the classroom.

It is possible to cover only a fraction of the desirable subject matter in a series of short-term courses or in a full-fledged master's program. However, experience shows that horizons can be vastly broadened and that practitioners can be provided with new concepts, tools and skills of value for both immediate responsibilities and professional growth. Once programs have been established, continuing education in these fields should take place over a lifespan.

Inasmuch as one course can either deal intensively with one problem area or superficially with a broad subject area, what is needed is a program of courses over a several year period which will cover the most critical areas or competences. The feasibility of providing academic credit should also be considered. If a course is aimed at a high content level, participants who desire credit can be graded on their project/clinical performance or be given a comprehensive assignment or examination. In fact, regular academic and short courses can be made complementary to each other. Increasingly, degree courses are being offered in units of time to accommodate work situations.

11. Implementation of short courses

Involvement of regional public works agencies in planning the non-degree training and development program is essential. Local chapters of APWA,

ASPA, ASCE, American Institute of Planners, the Council of Governments, the Federal Regional Executive Council or Board and other interested organizations should be included. One of the tasks of the advisory group is to enlist commitments by local, state, federal and private agencies in the area to assign employees under formalized staff development policies. The award of certificates for participation gives stature to the courses and a sense of achievement to the participants.

The time and location of courses are important. Scheduling in seasons or during times of the day when employees can be most easily released will facilitate attendance. If possible, the courses should be taken to an accessible location for participants. Availability of parking may determine the courses' success or failure.

External funding arrangements are desirable, since it is otherwise difficult to make training financially feasible. There are several possibilities. Some state agencies provide financial support for public service training. Intergovernmental Personnel Act funds can be used under specified circumstances as described in Part V, Sec. 6. Service agreements with state or municipal governments, federal agencies or public and private enterprises are more reliable methods than offering a course at a fee for each participant without assurance that the course will have enough participants. If the participants are guaranteed, the problem is solved.

A good training program cannot be achieved on an administrative shoestring. Some faculty member who can gain the respect and confidence of practitioners must be in charge and be provided with essential administrative support. A special unit within the center or the school of public affairs/administration may be established as the administrative vehicle.

Some academicians will oppose non-degree training. They will argue that such activity is not respectable for a university. (Admittedly, sometimes the courses are of such low quality that they warrant suppression.) But there are several selling points. If the training is of high quality and is well designed, it brings credit to the university. It requires more competent instruction and energizes the degree program. Short-term courses for senior practitioners often provide new approaches, cases, and problem-solving exercises beneficial to both academic courses and research. And, finally, they keep the faculty linked with agencies and practitioners.

12. Provision of research and related services

Part II, Sec. 10, stresses the importance of universities in the development and dissemination of both substantive and administrative knowledge for public works/environmental utilization. What is envisioned is not the casual reading, inquiry and writing which faculty members pursue to keep abreast of and contribute to the field as professionals. Such personalized research is essential, but it is only a backdrop to an institutionalized commitment and program.

To help fill the research void – especially in social, economic, financial and managerial aspects of public works planning and implementation and in processes of technology adaptation and utilization – universities should incorporate a major research and service division in their program. Here is where Option (5) has a great advantage, although a substantial contribution could be made under (2), (3) or (4) if the sponsoring schools exercise enough individual initiative.

The objective is to develop new concepts, systems and processes as well as incremental knowledge essential to good operations and improvement of performance. The product should consist of operationally useful studies, reports and monographs on ways to plan, develop, improve and manage public works facilities, programs, services and institutions. It should also be equipped to provide advisory services and information upon request. Some of this research is a normal part of any university program to be financed out of its own money. Most, however, must come from grants and contracts.

Participation in programs of sponsored research and consultation assistance by government agencies and private enterprise is one route to this objective. Initial efforts might well begin with research and service needs of local and state agencies and federal units within the region. Their need for assistance — often unrecognized — is most urgent. The staff and the faculty of the collaborating schools must feed them ideas and materials, show a genuine interest in their problems and demonstrate a willingness to tackle them without remuneration. No research and assistance program can be negotiated by browsing in the library and writing requests to Washington for a grant or contract. If the total program is developed cooperatively and staffed with persons who have the necessary capabilities, confidence will grow, research and service needs will be identified, and one project will lead to another. Public and private enterprises provide especially favorable opportunities for research and service collaboration with universities.

A corollary task which will open up research opportunities is to initiate a regional information service. Information required by the university for its own use and special data about practices and problems of the region can be compiled and circulated to local agencies and practitioners. The center or program may then cooperate with the APWA in establishing a Data System (see APWA Special Report, No. 36) and develop a public works data base for the region. In this way it can serve as a clearing house for new ideas and become a valuable source for both public and private agencies. University public works centers might also consider developing a subscription approach whereby they would supply regular information, documentation, inquiry services and limited consultation to public works agencies for a small fee ($200 to $2,000, depending on size of the agency). Naturally, such arrangements would include federal agencies and corporations.

To generate interest in and support for research and advisory service activities, APWA and NASPAA propose, as resources permit, to: (a) identify and publicize research needs (b) encourage governments and private corporations to foster, support and utilize essential research (c) press for the appointment of research officers or units in every sizable public works and environmental protection organization to conduct in-house research and to utilize the capabilities of university centers and (d) call the attention of governments to the need of incorporating an adequate allocation for research, development and training in every major public works/environmental program to assure that the program will become viable. This last point demands collective action inasmuch as federal appropriations for state and local public works have generally overlooked the necessity of a management training and research component. When funds have been available, they have usually been utilized only for technical training and studies. A network of university public works programs will help remedy this deficiency.

13. Technology development and application

Assistance in technology development, adaptation and utilization is an important part of the research function. With expanding national interest and support, conditions are favorable. Moreover, public works agencies and private enterprise are especially responsive to proposals relating to improved technology. Any university program in public works engineering should capitalize on this opportunity. A collaborative center for public works engineering and administration can make it a key element in its research and service program. This will enable administrative technology and systems to be given greater attention.

APWA is advocating a plan of action to bring technology dissemination and utilization efforts into some semblance of a collaborative system. APWA is already the principal broker and purveyor of new ideas and developments in its field. This is accomplished through several subsidiary institutes and committees; projects of the Research Foundation; workshops and seminars of the Education Foundation; APWA journals, manuals, reports, pamphlets, books, annual congresses; and special conferences; the Equipment Show; chapter activities; and inspection visits and exchanges among agencies. APWA is a made-to-order instrument to serve as the program wellspring and to perform a facilitative and switchboard role.

Effective utilization of technology depends upon the interest and competence of managers as well as their ability to develop an organizational structure motivated for this purpose. These are the kinds of persons the education/training programs described in this handbook will produce. Under this concept, existing *technology clearinghouse* efforts by federal agencies and programs sponsored by the National Science Foundation, Public Technology, etc., would provide major inputs for the use of public works agencies at all levels of government. APWA would also expand its Research Foundation program and engage in diversified arrangements to disseminate information and foster its utilization.

The network of university centers for public works engineering and administration now being encouraged by APWA and NASPAA would become both contributors of inputs and service stations in this enterprise. They would assist in technology assessments and applications for public agencies and public works-oriented groups in their regions. This is a proper feature of any research and advisory service. Other elements of the program include the use of regional field representatives by APWA to link clearinghouse efforts, universities, state and local agencies, chapters and communications media in continuous interaction. Local, regional and national conferences, meetings, case studies and publications would also be utilized. And contract services with universities and other research organizations could be employed to produce special reports, information and advisory services.

14. Administration of research and advisory services

Activation of a university research and service program requires preparation of a plan of action, assignment of responsibilities and working capital. Someone needs to give most of his time to the preparation of proposals, negotiation, organization of projects and supervision of the total effort. Therefore, the establishment of a research and service unit with a director is highly recommended. The new School of Public and Environmental Affairs at Indiana University has established a Research Division with a director and several full-time staff members. It is already engaged in projects operating in

excess of $1 million annually. If a collaborative public works center or program does not have sufficient capability to administer a research program, it can at least encourage individual school efforts and cooperation among them wherever located.

Since many research problems require a variety of disciplinary and professional inputs, the public works center should draw upon personnel from different parts of the university and join with other units which have the lead role. If universitywide research organs have been established, the center or constituent units may find it advantageous to carry on some of its work under such auspices.

This is not to suggest that all or most of the institutional research of the collaborating units comprising a public works center or program should be administered by the center or pooled in a broader university research agency. Ordinarily action research will take place in the professional schools most concerned. The purpose of a collaborative center is to pool resources, carry out projects having a broader scope than any one unit can cover and promote interchange and flexible staff assignments.

Under any of these arrangements there must be enough initiative and in-house research capability within the center or units to: (1) identify public works research needs (2) maintain liaison with other research units in the university and with APWA and similar groups (3) keep in contact with potential sources of funding and (4) assure implementation of a creditable research program. The sections in Part V dealing with agency programs suggest the kinds of projects and collaborative arrangements appropriate to an extensive research and service program.

15. Local and regional relationships

The success of any program depends on how well the university identifies its market, develops a network of relationships and clearly delineates the plan of action. Guidance and support by local and regional organizations are essential in activating each of its five program components: (1) graduate degree programs (2) in-service non-degree training projects (3) action-oriented research (4) advisory services and (5) informational services. In addition to local and regional public works/environmental agencies, these organizations include the APWA, ASCE and ASPA chapters; public service and engineering associations; the Federal Executive Council and Board; the metropolitan or regional council of governments; municipal, state and federal personnel offices; universities in the region; local foundations; contractors associations; and business corporations and firms which supply public works equipment, materials and technical services. An advisory council or board of visitors broadly representative of these interests may be helpful.

In fortifying the concept of a regional service center, strong and mutually valuable connectional links should be established between the university and practitioners. The center can become a powerful factor in upgrading public services in the region through service research, technology assessment and applications, advisory/consulting assistance on operational and managerial problems, and short-term training and academic programs. On the information front, a public works data system keyed to the APWA data project (noted in Sec. 12) provides a useful regional service. This can be supplemented by the compilation and circulation of memoranda and reports of value to agencies and practitioners.

16. Provision of resources

Success in carrying out any optional arrangement depends on the adequacy of resources. These include:

- a regular (hard money) or continuously assured special funding budget to cover minimal ongoing requirements
- sufficiently qualified full-time faculty and staff to cover principal courses; maintain relationships; and conduct research, short-term training and other service activities
- secretarial and clerical assistance adequate to get out the work, keep the records and tie the pieces together. In addition to persons engaged in general functions, one secretary/stenographer is needed for each two full-time faculty members
- fellowships (including supplements to help finance the cost of educating the student) and graduate and research assistantships
- access to library services which not only supply standard documents and other reference services, but also reports, studies and *fugitive* materials relating to public works/environmental engineering and administration
- computer resources including a data link to the university's computation center
- visual aid equipment
- office space, seminar rooms, facilities for use of visual aids and research areas suitable for such use and befitting the importance of the program

How much regular money would be required annually to maintain an Option (5) center as a coordinating mechanism to conduct a master's program in public works planning and mangement which enrolls twenty full-time and forty part-time master's degree students and to provide enough underwriting of non-degree training and research to build those programs? The following is illustrative.

Prototype Budget

A director who doubles as the staff head of the center and of the unit offering the master of public works planning and management degree (he would also teach)	$27,000
A full-time faculty position	20,000
Two adjunct professors (practitioners teaching one course)	4,000
Administrative assistant to help on recruitment, student services, non-degree training and related tasks	9,000
Graduate assistant, research assistant and university-provided fellowships (assumes other students would be sponsored on external fellowships or self-financing)	20,000
Secretarial and clerical	10,000
Office expense, reproduction and miscellaneous	5,000
	$95,000

The annual basic cost for modest programs under other options would be less. For example: Option (1) – $20,000 to $30,000; Option (2) – $30,000 to $40,000; Option (3) – $20,000 to $40,000; Option (4) – $20,000 to $30,000. The amount of new money depends on how much of the existing budgets and manpower can be converted to the new program. A budget of $100,000 should be easily feasible for any large university unless it is running

in the red with a ban on new programs. With rising costs, most institutions are in a squeeze. Nevertheless, numerous academic programs, especially in the disciplines at the graduate level, are producing in excess of market requirements. These could be curtailed with substantial savings.

However, for the reasons stated in Part II, Sec. 11, some universities will be unable to initiate a new public works program without external support. Possibilities include special state appropriations, grants by one or more local foundations, assistance from wealthy retired engineers, enlistment of help from the corporate foundations of private public works enterprises and suppliers and other sources suggested in Part V. One of the best devices is to secure fellowships which carry a supplement for the program. The minimum a university should allocate is the amount of income generated by tuition. A center or program needs full opportunity to negotiate for external funds. If budgetary support is not underwritten, any announcement of the program should be postponed.

Experience shows that once a quality program is launched, it quickly gains friends and earns respect. This lays the groundwork for seeking grants and for negotiating research and service contracts. In this way the university's allotment to the budget and other initial funds serve as a multiplier factor to produce resources which may be two or three times higher. Caution, however, is needed against building up a permanent staff that cannot be maintained if external funds should dry up.

17. Formalizing the plan

No new center or program should be initiated in the absence of both a long-term (five or six years) and first-year plan for which the necessary resources are committed or identified. Public affairs and public service education has been seriously impaired because trivial programs are announced without genuine university support. Development of a plan requires wide consultation in and out of the university. It should cover most of the subjects discussed in this handbook. If the objective is to create a nationally recognized center or program for public works/environmental engineering and administration, the plan should show the staging and timetable in a way to give assurance that the requisites and criteria capsulized in Appendix E will be met.

The plan should be approved by the head of each collaborating unit and formally endorsed by the head of the university or another appropriate official or body. Some aspects – for example, academic requirements or the award of a new degree – may require clearance with one or more academic organs and authentication by the board of trustees. Of critical importance is the commitment of budgetary funds as well as the enlistment of additional sources of funding.

Formulating and negotiating a plan for a new program or center requires considerable time and effort. This calls for some released time and other resources. Most schools work on such a close margin that they are unable to do a creditable job without a planning grant. From $10,000 to $15,000 is needed. APWA and NASPAA will endeavor to enlist funds to assist universities in preparatory studies.

PART V
COLLABORATIVE RELATIONSHIPS AND ASSISTANCE

If universities are induced to establish and strengthen public works/environmental education and research programs, there must be consultation and support from professional associations, government agencies, private enterprises and foundations. Part V discusses briefly the programs of important national organizations which should guide university initiatives.

Underlying all collaborative effort is the need for universities to develop close working relationships with local, state and federal agencies. They must also work closely with the public works business community for which its education, research and advisory services are designed to serve. Since these organizations are the beneficiaries, they have an obligation to initiate consultations and to press for action — as do the universities. To an extent, APWA collectivizes this obligation for the agencies, and NASPAA does the same for the universities. One of the purposes of this handbook is to stimulate all parties to get involved. Part IV, Sec. 15, describes how a university and organizations in the region it serves can work together to develop a first-rate program. Once a well-managed program gains a good reputation, it will enlist support from numerous sources.

Each university's efforts can gain strength from successful performance elsewhere, both by increasing a favorable public climate and by exchanging information. Experience in one institution in curricular development, course design, preparation of instructional materials, short term training and conduct of research should be shared with others. This is one reason why government and foundations should finance projects which benefit all universities.

1. Role of APWA/NASPAA

Since the federal government has not undertaken to foster nationwide public works educational initiatives, APWA took the initiative through its Education Foundation. ASCE and other professional groups are collaborating. When the APWA's Council on Graduate Programs was established, NASPAA became a partner.

APWA and NASPAA have agreed to consult with universities in developing or strengthening their programs. Several kinds of assistance are envisioned:

- Guidance on selection of the program option and plan of operation, including interpretation of the value of the program to university authorities
- Issuance of information on curriculum development and teaching methods
- Development and distribution of course outlines, textual materials, cases, simulations, project assignments and other instructional aids
- Dissemination of bulletins, reports, reading materials and other documents developed by universities, government agencies and organizations
- Conduct of discussions, workshops and meetings in connection with annual conferences of the two associations
- Encouragement of government agencies and business corporations to develop and distribute information on public works manpower requirements and in-service training policies
- Consultation with agencies, corporations and foundations on how they can best assist in increasing the university contribution (see Appendix A)

- Promotion of fellowship programs carrying supplements to help cover education costs
- Cooperation with individual universities in the interpretation of the value of proposed degree and non-degree programs, research and advisory services. (Local chapters of APWA, ASPA, ASCE and other public service and engineering groups will be encouraged to serve as partners in the enterprise. Many APWA chapters already have committees on education.)
- Dissemination of information about programs under development, the availability of teaching material, potential sources of financial assistance, etc.

The extent to which these kinds of assistances can be provided will depend on the success of associations in securing funds. For several years APWA has allocated a substantial amount of its own regular income to the Education Foundation. This has enabled sponsorship of the Pittsburgh pilot program. Such in-house funds that may be available in the future to assist individual universities will be concentrated on Option (5) programs, i.e., collaborative centers for public works engineering and administration. See Appendix E for requisites and criteria for such programs.

2. Public administration associations

A number of professional and public interest groups, which collectively comprise what is often called the public administration community, have a considerable stake in achieving the purposes of this handbook. These groups are, for example, the American Society for Public Administration (parent organ of NASPAA), the National Academy of Public Administration, the International City Management Association, the American Society of Planning Officials, the National League of Cities, the National Association of Counties and the Council of State Governments. There are also those associations in the specialized fields of public works – such as water, highways, electric power, environmental engineering and protection, etc. – which are equally interested.

The Standing Committee on Education of the National Academy of Public Administration wishes to promote the kinds of programs outlined in the handbook. The committee supports close cooperation between professional schools in universities and government, in integrating programs designed to improve the preparation of professional administrators for public service. This handbook has benefited from the Academy's study for NASA on "Transformation of Scientists and Engineers into Managers" (see Part II, Sec. 5). The Academy is presently engaged in a companion NASA project – the preparation of proposals for pre-service and in-service training and measures to develop managerial and related public affairs competences in its administrative personnel.[7]

3. American Society of Civil Engineers

ASCE is another source of advice and guidance. It devotes much effort to strengthening civil engineering education. (See, for example, the conference on this subject at Ohio State University, February 28 to March 2, 1973.) Its Director of Educational Services has assisted in the preparation of this handbook.

[7] The information contact point in the Academy is the Executive Director, National Academy of Public Administration, 1225 Connecticut Ave., N.W., Washington, D.C. 20036. For ASPA, the contact person is the Executive Director at the same address.

ASCE encourages the development of engineering management programs by awarding ASCE graduate fellowships in civil engineering management. Twenty-five fellowships totalling $50,000 were granted from 1967 through 1971. Students in Option (2) or in dual degree programs under Options (3) or (5) are eligible. ASCE student chapters offer a vehicle for fostering interest among engineering students in public works/environmental problems and for acquainting them with opportunities for graduate study.[8]

4. Financing programs

A university wishing to organize a new program under any of the options must be prepared to allocate sufficient funds (hard money). Generally this becomes possible only when some external funds are made available.

Governments must realize that universities can seldom use regular sources of income to finance a new graduate professional education program serving a special clientele — unless it is a state institution for which state appropriations are increased for the purpose. Tuition covers only a small portion of education costs, and few students can be expected to pay for this kind of preparation out of personal funds. Government financing is both necessary and proper.

To begin, a university needs to capitalize on all of the sources it can find — informational, financial and otherwise. The relevant activities of a number of national agencies are described below; few of these have much potential for initial financial help under the present federal policies. While early contacts with these agencies are desirable, primary reliance must be placed on sources within the state or metropolitan area. These include state and municipal governments, business enterprises and firms engaged in public works/engineering services, contractors associations, foundations and private philanthropists.

5. Federal strategy for public service education

Federal leadership in education and research for public works fields should be a part of national strategy to produce the persons and knowledge necessary to make the federal-state-local system manageable and to assure effective implementation of governmental programs. Unfortunately, we find no strategy other than to let individual agencies go off in separate directions, making *peace* where they can with central government offices. We find no administration policy of a positive character. Presidential offices seem unconcerned with public service education and action research as a principal means of improving executive performance, and the universities have no central place to consult on how they should respond.

At one time there was the beginning of a federal strategy. The Executive Branch developed and the Congress enacted, as Title IX of the 1968 Higher Education Act, an Education for Public Service program. Its purpose was to create and strengthen efforts of universities to provide professional education for public administration and related public service personnel. This was to be accomplished through several types of assistance, including fellowships to talented young persons. In other words, this was a means of initiating programs of the kind described in this handbook and enrolling highly qualified pre-service persons in them. In Title IX hearings, the Department of

[8] The information contact point is Director, Educational Services, American Society of Engineers, 345 E. 47th St., New York, N.Y. 10017.

Health, Education and Welfare (HEW) specifically pointed out how the proposed program could remedy the lack of education for public works.

Title IX was originally a part of a broader proposal encompasssing what later became the 1970 Intergovernmental Personnel Act (IPA). IPA has been financed, but the present administration has not requested appropriations for Title IX. HEW along with the Office of Management and Budget (OMB) and the Civil Service Commission (CSC) have not supported funding. The grounds for inaction seem to be that Title IX is an "aid to education" among other specific categories of aid to be combined or discontinued. In reality, Title IX, like IPA, is a vital component of any governmental strategy to improve management and performance; its rationale is certainly not to assist the financial plight of colleges and universities.

Some members of Congress understand this and have made overtures to include the funds for Title IX in the HEW appropriation bill. If this is accomplished, there will be some resources to carry out the purposes set forth in this handbook. That alone should be sufficient justification to fund Title IX. Under revenue sharing, the federal government has an added reason – if it ever needed one – to initiate an adequate program of public service education and research. Without the kinds of professionals described in this handbook, how can the federal-state-local public works system become effective?

The present situation is anomalous. CSC sponsors assignments under the Federal Employees Training Act and encourages agencies to develop training programs. The Commission's short term residential courses at the Federal Executive Institute in Charlottesville and at its centers in Kings Point, Oak Ridge and Berkeley are good and have involved some public works officials. OMB has similarly instructed twelve federal agencies to assign 7,000 to 11,000 career managers and executives to participate in formal management training in 1974. This includes executives in the supergrades and in GS13 to GS15. All federal agencies have been required to budget for and expand their existing development programs for 1975. CSC's residential centers will be utilized as well as other training facilities, and for some persons *mobility assignments* will be arranged.

The anomaly is that these meritorious efforts are not an additive or even complementary to a nationwide effort to provide university education in the various public service/administration professions. The result is that government fails to utilize the great potential of higher education except in fragmentary ways in producing the administrative capability necessary to make the federal-state-local system manageable.[9]

The purpose of commenting on this situation is to encourage not only public works but other sectoral officials, professional and public interest associations, universities, OMB and CSC to look at the total problem and to consult with each other in the formulation of satisfactory and balanced strategy. State and local government organizations should also be involved in consultations. Surely better arrangements are needed to provide an effective liaison between governmental agencies, public affairs/administration schools and university centers. NASA provides one example of a federal agency which has developed formal and mutually beneficial relationships with the public administration community.

A few federal agencies involve universities in education and research in

[9] There are some signs of a reversal in federal policy as indicated in the following Sec. 6 on the Bureau of Intergovernmental Personnel Programs.

substantive areas. The Department of Agriculture allocates millions of dollars annually to agricultural education and research. The Office of Education does the same in regard to preparation of school teachers and other educational personnel. Health, medicine, science and military services are further examples. Several agencies are conducting programs – a few under expansion but most under curtailment – which have important immediate or long-term collaborative potential for centers and programs in public works engineering and administration. The following sections provide a scoreboard.

6. Intergovernmental Personnel Act

CSC is the central agency of the federal government concerned with manpower planning, recruitment, training, internships, faculty development, equal employment opportunity, labor management relations and intergovernmental personnel management improvement. Recently it recognized the need for "the establishment and maintenance of effective relationships with the university community" by designating the Bureau of Intergovernmental Personnel Programs as the CSC's central office on such relationships.

This bureau is responsible for administering the Intergovernmental Personnel Act which offers four means of expanding education/training in public works planning and management. The first is through approved state or local short-term in-service training programs. Public works projects are ideal components of such programs, and several are now underway. Projects to develop management training materials requested by state and local governments are eligible for funding.

A second method is through assignment of state and local public works employees to universities under fellowships financed in part by federal subvention. Federal agencies are authorized to pay the full amount for tuition and incidentals, but only up to 25 percent of salary; state and local governments must pay at least 75 percent of the employee's salary as well as the cost of a replacement. But because state and local agencies are reluctant to release employees and to accept the financial burden, their participation is negligible. To insure local participation, the federal government will need to pay a larger portion of the cost. Lack of adequate appropriations have stymied this program.

A third and very advantageous feature of IPA is the mobility assignment. Under this plan a federal employee can be assigned up to two years to a public or private university to help develop its public works program. If the university can persuade the employing agency that this is to its advantage, most or all of the salary cost will be borne by the agency. Federal employee salary, benefits and job rights are protected. Travel and moving expenses are authorized. In 1973 there were forty-five such assignments to educational institutions.

The reverse flow of personnel is also authorized. Staff members of a university public works program can be detailed or temporarily transferred to federal, state or local governments to serve as advisors, researchers, trainers, etc. This provides a means for upgrading academic instructors deficient in government experience. In both cases the length of assignment, type of appointment, and method of financing costs can be tailored to each situation.

The fourth opportunity available to public works personnel is admission to federal training programs. A number of courses are offered in the public

works field — "Waste Water Treatment and Disposal," "Water Resources Seminar," "Environmental Quality and Natural Resources," for examples.[10] The Bureau of Intergovernmental Personnel Programs is responsible for the other three activities and administers a proposed Government Affairs Faculty Fellowship Program as well as increased work experiences for students pursuing degrees in public administration. NASPAA is formally working with the Bureau of Intergovernmental Personnel Programs to encourage the use of Title IV of IPA to place university faculty members in federal agencies through its Public Administration Fellows Program. NASPAA will supply information and assist in such arrangements.

Budget requests for IPA funding have been miniscule — only $10 million for 1973-74. However, reflecting IPA Advisory Council recommendations, the President requested $15 million for 1975 and liberalization of the federal reimbursement on IPA fellowships.

Of great significance is a more recent action. On July 17, 1974, the President sent a message on Executive Development to Congress in which he announced a Program Management Fellowship proposal with selected universities to upgrade executives at all levels of government. To finance graduate fellowships for federal employees, a $10 million supplemental appropriation was requested under authority of the Government Employees Training Act.

To finance state and local fellowships, the President requested a $10 million supplemental for IPA fellowships, plus $5 million for other IPA purposes. Subsequently CSC requested Congress to amend the IPA authorization to enable reimbursements to state and local governments and to universities of up to 75 percent (instead of 25 percent) of the salary of recipients of IPA Governmental Service Fellowships.

These proposals are most heartening and warrant strong support from the public works community. Masters programs in public works planning and management are ideal for upgrading executives of all levels of government engaged in administering public works and related environment protection functions. However, these proposals only place further demands on the universities which must fund most of the developmental, instructional, and other costs. Without Title IX assistance and grants to develop program management curricula in major public service sectors, the universities will find difficulty in responding effectively to the added burden this proposed new program will place on them.[11]

7. HEW — Fund for the Improvement of Postsecondary Education

Pursuant to the 1972 Education Amendments Act, the Secretary of Health, Education and Welfare established the Fund for the Improvement of Postsecondary Education as a unit within HEW, headed by a director and assisted by a fifteen-member board. The overall objective is to help postsecondary institutions and agencies improve their effectivenesss, quality and diversity. The purposes of the various educational initiatives described in this handbook reflect to a remarkable degree the eight purposes for which grants and contracts may be awarded. The Fund has issued "Program Information

[10] The contact point on this is the Field Division, Bureau of Training, U.S. Civil Service Commission, Washington, D.C. 20415.

[11] Contact point on all such matters is Director, Bureau of Intergovernmental Programs, U.S. Civil Service Commission, Washington, D.C. 20415.

and Application Procedures" for 1974; December 15, 1973, was the deadline for preliminary proposals. Hopefully this program will continue to be funded so that an institution wishing to submit an application can do so in December 1974 and annually thereafter.[12]

8. Department of Transportation

Several units of the Department of Transportation (DOT) foster education and research, which is highly valued. But with the increased realization that more engineers and functional specialists who possess greater understanding of the administrative and environmental complexities of transportation systems (particularly in urban areas) are required, many persons believe that DOT's education and research should be expanded to focus on these problems.

Any large federal public works program involving state and local agencies should have training and R & D components built into it. University public works programs would have much to contribute. Such programs are also ideal for DOT staff development through assignment under the Federal Employees Training Act.

(1) *Urban Mass Transportation Administration:* UMTA has annually about $3,000,000 to devote to its university grant programs for training and research. While some of the projects have a considerable technological focus, the guidelines include problems of land use, planning, urban development, organization, finance and other administrative aspects of urban transportation.

University centers which link engineering, environmental planning, urban planning, business, economics and other resources concerned with urban transportation and schools of public affairs and administration should have exceptional capability in producing both trained administrators and operational research of a kind that is now in scarce supply. Universities interested in these possibilities should secure UMTA Guidelines for University Research and Training Grant Programs and maintain close contacts.[13]

(2) *National Highway Institute:* The Institute is responsible within the Federal Highway Administration for administering – in cooperation with state highway departments – programs of education and training for federal, state and local highway agency employees. The states are permitted under the enabling legislation for the Institute to expend up to one-half of 1 percent of their regular federal-aid highway funds on a 70 percent federal/30 percent state matching basis for education and training of their employees.

The Institute attaches much importance to programs of continuing education to help practicing engineers presently employed in state and local highway agencies to become more proficient in the management and supervisory aspects of their work. Accordingly, the Institute encourages highway agencies and their employees to avail themselves of

[12] Contact point is the Director, Fund for the Improvement of Post-secondary Education, Department of Health, Education, and Welfare, 400 Maryland Ave., S.W., Washington, D.C. 20202. Telephone 202-245-8091.

[13] The contact point is Director, Research and Education Division, Office of Research and Development, UMTA, Department of Transportation, Washington, D.C. 20590.

training opportunities in administration and management. Federal-aid highway funds may be used for such training.

Two FHWA programs for granting individual educational assistance are important means of assisting state and local highway agencies. These are administered by the Institute. The Fellowship Program in Highway Safety is designed to support the Governors' Safety Programs and is oriented toward individuals employed in the technical and administrative aspects of highway safety. The Fellowship Program in Highway Transportaton Research and Education promotes interdisciplinary study and research. Public administration is among the eligible disciplines for research and study under this program.[14]

(3) *Office of Assistant Secretary for Systems Development and Technology:* This Office is responsible for the university research program, the purpose of which is to insure that the resources of higher education are effectively brought to bear on national, state and local transportation problems. The program is undertaken by faculty members and graduate students through contacts with their institutions. In addition to transportation research, university-based seminars and conferences are sponsored to bring university, industry and government representatives together for joint projects and to provide additional mechanisms for transferring the results of the research to the potential user.

The objectives of the program are:

- To stimulate relevant high quality and innovative transportation research at universities for the creation of new concepts, techniques and knowledge while encouraging the development of highly skilled professionals in transportation
- To increase the effectiveness of universities in helping to solve state and national transportation problems
- To encourage the use of modern tools of analysis, planning and management; new technology; and professionally trained people by state and local transportation agencies and by industry
- To stimulate industry, state and local agency sponsorship of university-based transportation research
- To assess the demand for professional manpower in transportation and to project future training requirements.

It is the intent of the University Research Program to fund faculty and graduate students to conduct mission research in transportation, not to provide blanket support to administrative units in universities. However, the department believes that leadership is essential within universities if interdisciplinary activities are to succeed.[15]

9. Department of Housing and Urban Development

Graduates of programs in public works planning and management are ideally qualified for major responsibilities in community development, housing, model cities and other urban programs. Engineers capable of planning, evaluating, constructing and managing urban infrastructure and

[14] Contact point is the Director, National Highway Institute, Federal Highway Administration, Department of Transportation, Washington, D.C. 20590.

[15] Contact point is the Director, Office of University Research, Office of the Assistant Secretary for Systems Development and Technology, Department of Transportation, 400 7th St., S.W., Washington, D.C. 20590.

services are needed by the Department of Housing and Urban Development (HUD) and by state and local agencies involved in such programs. The HUD fellowship program, which for several years supported graduate preparation of young men and women in relevant fields including public works, has been abolished. Nothing has replaced it as yet.

Currently there are two ways a university public works center can serve the training needs of HUD as well as state and local agencies receiving HUD funds:

(1) Providing relevant professional education for HUD employees assigned under the Federal Employees Training Act

(2) Utilization of the fellowship provisions of the Intergovernmental Personnel Act for advanced education of state and local employees working on HUD-assisted programs.

Mobility assignments, authorized by the Intergovernmental Personnel Act, are supported by HUD and have great potential. But projects are no longer available under Section 701 funds. Presumably state and local government can use grant funds to secure university research and assistance.

HUD has contracted with universities for various kinds of research. An interesting example is the Urban Observatory Program. If a university develops research capabilities in public works planning and administration, it should explore the possibility of HUD contracts. An information bulletin, "Force to Change," describes HUD programs and how universities may solicit proposals. [16]

10. Environmental Protection Agency

Extensive training grants have been provided by the Environmental Protection Agency (EPA) and its predecessor agencies, particularly for advanced work in graduate schools of public health. A few projects, which focused on planning and administration, involved schools of public and urban affairs. EPA training grants have been greatly curtailed with reduced concern for the preparation of personnel for environmental engineering programs at state and local levels. In fact EPA has advised that an agency decision has been made to phase out professional training by June 30, 1976. During the phase-out period, grants will be awarded in conformance with the training grant and fellowship regulations published in the *Federal Register*, June 20, 1973. Most training grants relate to scientific, engineering and technology matters – not to the kind of planning and management competences described in Part II.

This phase out is perplexing in relation to federal policy on general and special revenue sharing. Is it not desirable that the federal government take steps to assure that these funds as well as the EPA program itself will be effectively implemented by making possible the essential education and upgrading of professional personnel? Surely the universities cannot be expected to train all of these specialized persons out of their own scarce funds. From where are the qualified persons to come to plan, operate and improve the technology and to manage the environmental public works and protection systems at federal, state and local levels?[17]

[16] Contact point is Office of Assistant Secretary for Research and Technology, Department of Housing and Urban Development, Washington, D.C.

[17] Contact points are the Director, Office of Education and Manpower Planning and/or Chief, Grants Information Branch, Grants Administration Division, Environmental Protection Agency, Washington, D.C. 20460.

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Universities are eligible applicants for a variety of EPA research and demonstration grants. Some of these seem applicable to university programs or centers in public works/environmental engineering and administration, notably for collaborative implementation with other university units. Comprehensive grants for environmental protection, air pollution control, solid water research, water pollution control and water supply research are examples. These grant possibilities are described in a bulletin issued by EPA's Office of Research and Monitoring and published in the *Federal Register*, May 15, 1973.[18]

11. National Science Foundation

The National Science Foundation (NSF) has reoriented its traditional emphasis on fundamental disciplinary research by establishing programs of support for the study of operational problems involving the contribution of the professions.

Change began in 1971 when NSF was assigned responsibility for research in urban, social, environmental, transportation, energy, productivity and other multifaceted public problem areas. Key factors in such problems are their action-focused interfaces of public policy, political processes, institution building, management, finance, human relations and the interdependency of federal, state, municipal and private systems. For solutions, these problems require direction or participation by persons with a multidisciplinary-based professional or operational commitment. Schools of public (urban) affairs/administration and centers for public works engineering and administration are places which should have interest in and competence to deal with these interfaces.

Recognizing these broader inputs, NSF initiated a promising program known as RANN, "Research Applied to National Needs," which opened up opportunities for research in public works/environmental policies, planning, operations, finance, systems, resources, organization, management,evaluation, etc. This program provides grants in five broad areas:

(1) social systems and human resources
(2) environmental systems and resources
(3) advanced technology and applications
(4) exploratory research and problem assessment
(5) advanced energy research and technology

Projects should highlight policy implications and have identifiable long-term benefits. Projects which mobilize a combination of disciplinary and professional personnel are especially favored. Collaborative centers/programs in public works/environmental affairs are prepared to initiate such projects, since they already mobilize a variety of inputs and could readily involve participation by other units and specialists.

Of special significance to the RANN program and to orienting NSF to state and local problems is the work of the Office of Intergovernmental Science and Research Utilization. This office sponsors policy studies and demonstrations to enable state and local governments to plan and establish their research management and utilization capabilities. It is responsible for (1) developing agendas of user needs that are considered in formulating the content and direction of RANN's research programs and (2) ensuring the

[18] Contact point is the Director, Grants Administration Division, Environmental Protection Agency, Washington, D.C. 20460.

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application and dissemination of RANN research products to appropriate user groups, both public and private.

A relatively new NSF activity, which is important to public works engineering and administration, is the Public Sector Program. It is one of two units under the Foundation's new Experimental Research and Development Incentives Program, and it supports experiments and background studies for potential adaptation by local, state and federal agencies. Its purpose is to develop ways of strengthening government agencies' capabilities at all levels and to utilize research and development more effectively and speedily. This should result in the application of new or improved techniques, products and processes. Emphasis is placed on developing new institutional and intergovernmental arrangements among state and local governments, industries, universities, federal laboratories and non-profit research institutions to increase communications among suppliers and users of R & D.

Universities should also examine the desirability of becoming related to NSF financed problem assessment studies initiated by state and local governments. A number of such projects are already underway. In many cases, linkages between centers and governments in formulating and carrying out such undertakings should be mutually advantageous.[19]

12. Other federal agencies

A number of other federal agencies are engaged in public works functions and offer potential opportunities for collaboration with universities. The Army Corps of Engineers has played an historic role in civilian as well as military public works. It assigns military and civilian personnel to universities for advanced preparation and enters into research and service contracts.

Navy civil works has also developed into a substantial operation with very important environmental protection aspects. And it cherishes cooperative relations with universities. The General Services Administration constructs, maintains and manages the federal system of buildings. Those university programs with capabilities in this field will find contacts mutually advantageous. The Tennessee Valley Authority and other special-purpose agencies are illustrative of federal organizations with a substantial public works component. The manpower training program of the Department of Labor, now highly decentralized to state and local governments, provides substantial funds which can be used in training technicians and other categories of personnel employed by public works agencies.

13. State and municipal agencies

State governments, counties and municipalities should assume greater leadership in public service manpower planning within the regions they serve and in building university capabilities to fulfill both personnel and research needs. This responsibility has been further underlined by revenue sharing. To this end, chief executives of such governments should develop – with the aid of their personnel, budget, planning and administrative improvement officers

[19] Contact points are the Director, Office of Intergovernmental Science and Research Utilization, The General Program Divisions under RANN, and the Public Sector Office of the Experimental R & D Incentives Program, National Science Foundation, Washington, D.C. 20550.

as well as their program departments - the necessary staff development policies and procedures, training plans, tuition support, released time, education leaves, research projects and other cooperative endeavors. This entails decisions in respect to particular training projects (both academic and non-degree) and means for funding.

Arrangements for administrative and technology research and services require planning and cooperation, recognizing that most projects will be conducted *ad hoc*. Councils of Governments, Federal Executive Councils and Boards and Chapters of APWA and ASPA can be of considerable help in making such arrangements. The only obstacle is lack of awareness of the need of such arrangements. This is where national societies and associations of governments have a role. APWA will inform public works agencies; NASPAA will alert the universities; and four associations are in positions to encourage chief executives: the Council of State Governments, National Association of Counties, National League of Cities, and International City Management Association. The International Personnel Management Association should also be involved.

14. Foundation support

Some national and local foundations have substantially assisted public service and engineering education in a few cases. Very little has been done to foster combined efforts of the kind recommended in this handbook because the case has never been presented. This is a first attempt to provide a rationale.

Hopefully, some foundations will wish to take advantage of the opportunity to help create and support university centers and programs for public works/environmental engineering, planning and administration. An investment in planning a program, providing instructional capabilities, preparing teaching materials or in financing fellowships and research assistantships would produce the people and knowledge essential in making urban society livable. It would also increase the quality and cost effectiveness of the $60 billion spent annually for public works/environmental facilities and services.

To enlist foundation interest, the importance, practicality and evaluated results of education/training programs must be presented in a variety of ways over a long period of time. Foundations respond to the interests of their boards and staffs and to the persuasive appeal of those who submit proposals. Since there is no background of interest in the kind of needs and opportunities outlined in this handbook, much groundwork needs to be laid. This can be done by universities working with foundations in their region. Public interest and professional associations should take the initiative with respect to national foundations.

15. Business enterprise and industry

Private enterprise is engaged in four different services of a public works character. First, there are the privately developed and operated energy, water, transportation, communications, industrial parks, housing, urban development and new town enterprises and systems.

Second, there are the large numbers of companies which produce equipment, materials, systems and services required for urban and national infrastructure.

Third, there are the contractors who construct and sometimes maintain

under contract public works structures and facilities.

Fourth, there are the engineering and consulting firms which plan, design, evaluate, inspect and advise. Some corporations and firms cover two, three or even four of these services.

All of these enterprises have need of engineer-administrators for their own planning and management purposes. Moreover, if municipal, county, state and federal agencies are not staffed with such individuals, corporate plans and projects will not receive understanding attention. Equipment and services will be poorly used, and working relationships between public employees and the companies which supply them will be beset by frustration.

Thus for purposes of self-interest as well as to advance education and research, private enterprise should be receptive to proposals for assistance in establishing public works centers and programs. Several national corporations already provide fellowship assistance. Collaboration between a center and a corporation on training, research and development can be mutually advantageous. Joint industry/university research is encouraged under some federal grant programs. Every center should develop these linkages with industry in its region.

16. Fellowship supplements

One of the most effective ways to support public works educational programs is to make available fellowships which include a supplement to help cover the cost of educating the recipients. The supplement should be one half of the amount of the stipend for the student or be equal to the rate of tuition, whichever is higher. Such fellowships enable both pre-service and in-service persns to be recruited, and at the same time they provide the university with a part of the additional direct costs of educating the fellowship holders. (It costs two to four times the amount of income from tuition to educate a professional graduate student.) Both APWA and NASPAA administer fellowships of this kind. Thus fellowship allocations can be made to the associations which in turn screen applicants and assist in the selection of the institution which best serves an applicant's needs.

17. Utilization of training resources

A considerable number of public works training courses are now offered by APWA, government agencies, public interest organizations and universities. Not only should these resources be fostered and supported for training purposes, but they also can be drawn upon for instructors and instructional material. In some cases, the combination of forces will be advantageous. The National Training and Development Service for state and local government – a joint enterprise of several public interest associations – will offer assistance to APWA, NASPAA and universities in the development of instructors and in organizing training projects.[20]

The Director of the Bureau of Training, United States Civil Service Commission, writes: "I feel there are many already existing opportunities for training responsive to the needs and objectives your working group has identified. In agencies, as well as throughout the Commission's nationwide training system, many training courses are readily available to your constituency in

[20] Descriptive materials can be secured by writing to the President of the Service, 1140 Connecticut Ave., N.W., Washington, D.C. 20036.

general management, personnel management and labor relations, ADP, management sciences, etc. During the last Fiscal Year 12,000 state and local employees participated in Commission-conducted courses."

18. Teaching and other materials

In view of the past neglect of public works education, teaching material is very limited. A considerable amount of material, together with curriculum development and guidance on teaching methods, needs to be centrally prepared; unless more materials are prepared in advance of the establishment of new public works/environmental centers and programs, such efforts will be severely handicapped. The syllabi, course outlines and instructional material utilized in academic courses in public works planning and management curricula should be assembled and exchanged. APWA, Civil Service Commission and agency training materials can all provide contributions. The Pittsburgh Center has taped its seminars on public works management in developing countries and public works planning and implementation. It is ready to summarize these transcripts and combine them with discussion guides, simulations, project assignments and handouts to form training kits. (See Appendix C.)

APWA and NASPAA both desire funds to enable this assembly, annotation and packaging of instructional materials as well as the preparation of new texts, readers and handouts.[21]

19. International collaboration

The training of public works engineers, planners and managers in foreign countries — particularly low-income countries where public administrations are less developed — is equally urgent.

The International Association of Schools and Institutes of Administration, an organ of the International Institute of Administrative Sciences (IIAS) whose headquarters are in Brussels, is encouraging the establishment of at least one public works education and research center in each country. The 1972 Caracas meeting of the International Association had as a major subject: "The Role of Schools and Institutes in Training Sectoral Administrative Personnel: The Potential in Public Works Planning and Management." It has selected this as a major field of initiative, including further consideration at its meeting in Mexico City in 1974. Copies of IIAS Schools and Institutes Circular No. 16, which contains the Caracas work paper and the 1974 presentation "Strengthening of National Systems for Education and Training in Public Works/Environmental Planning and Management," can be secured from APWA or NASPAA.

On a broader front, an Interagency Working Group in Public Works Management is fostering training efforts nationally, regionally and globally. It recommends preparation of a handbook for use by developing countries on "Organizing Training Programs in Public Works/Infrastructure Planning and Management"; formulation and distribution of teaching materials; and greater initiative by international organizations in providing technical assistance for the improvement of public works planning, organization, management and training.

[21] Contact point is Director of Education, American Public Works Association, 1313 E. 60th St., Chicago, Ill. 60637; and Don M. Blandin, Staff Director, National Association of Schools of Public Affairs and Administration, 1225 Connecticut Ave., N.W., Washington, D.C. 20036.

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The cooperating agencies include the United Nations, International Bank for Reconstruction and Development, Pan American Health Organization/World Health Organization, International Labour Organisation, Organization of American States, Interamerican Development Bank, United States Agency for International Development and the International Institute of Administrative Sciences. Consonant with the proposals of these groups and stimulated by them, the Pan American Health Organization is applying them in water supply, sanitation, solid waste and related environmental protection fields. The Asian Center for Development Administration in Kuala Lumpur (a United Nations Agency) is initiating a program in Infrastructure Management.

United States centers have much to gain by participation in these movements. Public works programs in universities serving overseas students can provide training opportunities for foreign engineers who are sponsored by development assistance organizations or their home governments.[22]

20. Information

For further information regarding these guidelines and criteria, contact: Donald C. Stone, Chairman, Council on Graduate Programs in Public Works Administration, 501 Bruce Hall, University of Pittsburgh, Pittsburgh, Pa. 15213. Telephone: 412-624-4770

Robert F. Wilcox, Chairman, Committee on Public Works/Environmental Administration, Graduate School of Public Affairs, University of Colorado, Boulder, Colorado 80302. Telephone: 303-443-2211, Ext. 7045

Inquiries may be made directly to the national associations as follows: Robert D. Bugher, Executive Director, American Public Works Association, 1313 East 60th Street, Chicago, Illinois 60637. Telephone: 312-947-2520

Don M. Blandin, Staff Director, National Association of Schools of Public Affairs and Administration, 1225 Connecticut Avenue, N.W., Washington, D.C. 20036. Telephone: 202-785-3260

[22] Contact point for the International Association of Schools and Institutes of Administration is Donald C. Stone, Chairman, 501 Bruce Hall, University of Pittsburgh, Pittsburgh, Pa. 15260. Contact point for the Interagency Working Group is Michael Bentil, Public Administration Division, United Nations, New York, N.Y. 10017.

APPENDIX A

APWA RESOLUTION ON TRAINING AND DEVELOPMENT FOR PUBLIC WORKS

(Adopted by the American Public Works Association, September 16, 1973)

WHEREAS developing, managing and coordinating the nation's public works facilities and services in relation to social, economic and environmental realities requires high administrative competences among practitioners at all managerial levels, and

WHEREAS an insufficient number of preservice and inservice personnel acquire university and other kinds of training in public works engineering and administration in order to provide such competences, and

WHEREAS the American Public Works Association, in cooperation with other national organizations and government agencies is fostering university programs, management seminars, workshops and other opportunities to produce the necessary competences, now therefore be it

RESOLVED I. That all governmental and other agencies engaged in public works functions be encouraged to formulate and implement continuing programs of employee development under which each regular employee is provided with training and learning opportunities consisting, during his or her career, of whatever combination of on the job training, assignment to short courses and workshops, and part-time or full-time university programs related to the employee's responsibilities as may be appropriate;

II. That the APWA Education Foundation continue and expand, as resources permit, its efforts to offer seminars and workshops, to foster university centers in public works engineering and administration for both preservice and inservice education, to collaborate with other organizations in improving education and training programs of value to public works practitioners, and to disseminate to public works agencies information on all such worthy training opportunities; and

III. That local and state as well as federal public works agencies provide released time and assume primary responsibility for financing the costs of training assignments as a part of the operational expense of the agency as now practiced by an increasing number of jurisdictions and by private enterprise, including assignment where appropriate to university public works engineering and administration centers for part-time or full-time study; and

IV. That the federal government, foundations, and business corporations be urged to establish national fellowships and assistance for developing instructors and teaching materials; and

V. That a copy of this resolution be sent to the chief officials of all jurisdictions engaged in substantial public works functions and undertakings.

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APPENDIX B

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APPENDIX C

ILLUSTRATIVE COVERAGE OF A TWO-TERM SEQUENCE OF BASIC COURSES IN PUBLIC WORKS MANAGEMENT

The following illustrates the subject matter of two core courses which incorporate many of the elements of the NASPAA matrix in the context of policy and program issues. They are required courses offered at the University of Pittsburgh for overseas engineers and other persons interested in public works planning and management. They parallel Public Works Management I and II which are designed for students of the United States who are working for a master of public works degree. They are conducted to a large extent in a clinical or problem-solving manner.

A. **First-term course: Public Works Management.** The following subjects developed under this course have demonstrated their value for inclusion in both academic and non-degree training programs.

1. Purpose, elements and contribution of the public works/infrastructure sector; impact of urbanization and industrialization; environmental and resource factors
2. Comparative approaches to government organization for public works functions; the role of public and private public works enterprise
3. Achieving a national/regional/local public works system and subsystems as part of an effective government system for development
4. Common administrative obstacles to better performance in the public works sector and requisites for their removal
5. Theories and concepts of organization and management which have practical value for the public works practitioner
6. Essential tasks or elements of management and their applicability to public works functions
7. United Nations assessment of needed improvements in national public administrations and programs recommended for the Second Development Decade; public works as a sector of Specialized Agency concern
8. Organizational requisites and options to implement public works functions, programs and projects
9. Executive management in achieving policy and program objectives
10. Development of managerial resources and processes
11. The role and methods of the public works supervisor
12. Application of consultative or participatory processes in management and supervision
13. Improving the recruitment, selection, development, classification and compensation of public works personnel
14. Working with labor unions (collective bargaining)
15. Public works financial management
16. Application of program budgeting to public works
17. Procurement and supply management
18. Contract management for construction projects
19. Elements of a comprehensive program to improve public works management

B. **Second-term course: Public Works Planning and Implementation.**

1. Economic and social development planning: implications for public works infrastructure
2. Public works planning as a part of national development planning
3. Urban land use and public works planning
4. Environmental factors and consequences; water, air, and noise pollution control
5. Limitation of resources; effective utilization and conservation
6. Public works in relation to poverty and unemployment; labor vs. capital intensive policies and projects
7. Implications of the United Nations International Development Strategy for the public works sector
8. Evaluation of the operational and administrative practicality of public works sections of national development plans
9. Reducing planning and administrative constraints to development
10. Role of capital and current budgeting in plan and program implementation
11. Making PPBS operational for public works functions
12. Design of public works programming/budgeting/accounting/reporting systems
13. Program and project design, evaluation and management
14. Public works manpower planning and development
15. Evaluation and strengthening of the administrative capability in public works organizations to implement plans, programs and projects
16. Alternative ways of identifying and remedying administrative breakdowns, inadequacies and poor performance
17. Continuous measures to increase administrative capabilities and performance
18. Conduct of administrative surveys and improvement programs
19. Planning and organizing training programs to improve performance

APPENDIX D
ILLUSTRATIVE SHORT COURSES

1. Public Works Management Seminar

The American Public Works Association has pioneered in developing intensive management seminars related to public works functions. A recent one-week seminar conducted by the University of Pittsburgh in cooperation with APWA in the latter's headquarters in Chicago covered the following subjects:

- Public works management and organization (two sessions)
- Executive views of management
- Applying behavioral sciences in public works management (two sessions)
- Public works cost management (three sessions)
- Systems analysis in public works (two sessions)
- Effective public relations
- Communication skills
- Agency communications
- Project planning and evaluation
- Management techniques
- Applying public works management practices
- Integrating modern management in public works organizations

2. OMB's Model for Short Courses

The United States Office of Management and Budget has developed a "model" basic curriculum for short courses in what it calls "management executive curriculum areas."

I. Environment of Managerial-Executive Performance
   - A. External environment of administration
     1. Social, political and governmental forces
     2. Public policies and liaison
   - B. Internal organization environment of administration
     1. Administrative organization, processes and behavior
     2. Alternative organization and management models and analysis

II. Managerial Systems and Processes
   - A. Administrative management
     1. Financial management
     2. Manpower management
     3. Property management
     4. Information management
   - B. Program and project management
     1. Planning and objective setting
     2. Resourcing and implementing
     3. Tracking and evaluating

III. Personal Management Skills
   - A. Self-assessment and self-renewal
   - B. Leadership skills
   - C. Communicating skills
   - D. Counseling and coaching skills

3. Three Week Public Works Management Course

A third illustration is the proposed content of a three-week seminar for heads of public works agencies:

- Character and causes of failures in achieving program and project objectives
- Evaluating administrative strengths and weaknesses
- Developing criteria and strategies for increasing administrative capability
- The executive's leadership and managerial roles
- Achieving a more effective management system
- The planning, programming, budgeting, accounting and reporting process
- Program and project evaluation
- Application of evaluation (analytical) techniques
- Decision-making in project resolution
- Designing a programming, budgeting and reporting system
- Manpower planning and staff development
- Training and learning methods
- Improving personnel management
- Building citizen, political and administrative support
- Politics, corruption, ethics and survival

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APPENDIX E
REQUISITES AND CRITERIA FOR OPTION (5) COLLABORATIVE CENTERS FOR PUBLIC WORKS ENGINEERING AND ADMINISTRATION

This part of the handbook has a specific and limited purpose. It sets forth minimum requisites for Option (5) programs, namely for the establishment of nationally significant centers for public works environmental engineering and administration. As described in Part III, these are collaborative efforts of schools of public affairs/administration, engineering and other units which include a basic master's program in public works planning and management and the opportunity for one or more dual degrees or certificates in fields of practice or cognate studies. While no attempt is made to provide specific criteria for options or alternative programs, some of the same criteria appear applicable and adaptable.

These capsulized criteria are presented primarily for the convenience of the APWA Education Foundation, NASPAA and institutions which desire to work together in establishing Option (5) programs. Because of APWA's limited resources, it is necessary to concentrate fellowship and other financial assistance on Option (5) centers. However, both associations encourage universities to select one of the five options that best suits their interests and capabilities.

As stressed in Part III, centers must be designed in accordance with each university's particular situation. Variation and experimentation are inevitable and desirable in the initiation of new programs. Some requisites are essential for any program, and the following are considered applicable to institutions which have the aspirations and resources to develop a full scale collaborative center for public works engineering and administration. Their application will reflect academic/professional quality equivalent to the standards of first-rate schools of public affairs/administration, engineering, law, public health, business, etc.

1. Objectives

The objectives of a collaborative center for public works engineering and administration are to:

(1) Provide pre-service and mid-career graduate education for engineers and other personnel responsible for planning, building, operating, maintaining and managing the nation's public works and related environmental functions
(2) Offer short courses, workshops and non-degree training for service personnel
(3) Conduct action-oriented research for operational guidance and instructional purposes
(4) Provide advisory services to public works organizations and officials and
(5) Compile and disseminate information of value to public works agencies and practitioners and to serve as a regional clearinghouse

2. General characteristics

The center should be a collaborative entity or cluster of integrated programs in which a school of public affairs/administration, a school of engi-

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neering and other academic units, such as public health, urban planning, environmental sciences, business, medicine, etc., pool their efforts in furthering the above objectives.

The academic degree programs sponsored by the center should:

(1) Be professional and multidisciplinary in character
(2) Include as a basic component a master's program with a primary concern for policy, planning, operations and management
(3) Relate the administrative concerns of teaching and research to a broad range of important public works functions or subfields (See Part I, Sec. 3.)
(4) Provide dual degree or cognate study opportunities in substantive fields of practice
(5) Feature the interests and needs of experienced practitioners and
(6) Have an organizational structure that gives it substantial stature in the university constellation and makes it free of the domination of any single discipline or department.

The main feature of the enterprise is a master's program in public works planning and management with dual degrees and study opportunities in engineering, public health engineering, urban planning and development, environmental science, etc.

3. Structure

Inasmuch as the center will bring together the academic and research efforts of two or more schools, its structure will ordinarily consist of two elements:

(1) A collaborative entity with a suitable title such as "public works engineering and administration," "public works and environmental administration," etc. The entity is governed by a correlative policy committee of deans of the sponsoring schools and a staff director. Such deans are accountable collectively to the general authority of a chief administrative/academic officer of the university.
(2) A "public works planning and management" master's degree component normally offered by the school of public affairs/administration. It may be jointly offered by the center together with dual degree and academic and research components of participating schools.

The center may simply be an instrument to achieve coordinated planning and implementation without a director, budget or staff. However, it may become a sizable operational entity.

The public works planning and management component of the school of public affairs/administration requires a full-time head. It may also provide staff support for the center and serve as the administrative instrument for the jointly conducted short courses, research and service activities. Under any arrangement, the heads of the schools or departments concerned need to comprise a consultative group, fostered and sustained by a chief university officer. Working groups of faculty from the cooperating units deal with specific problems and tasks.

4. Curriculum

The graduate program in public works planning and management should:

(1) Be specially designed – not merely an additive to present courses nor a collection of existing courses under a new program label

(2) Have an applied public policy, planning, operational and implementation focus
(3) Involve interface with other public service sectors, levels of government and professions
(4) Integrate political, economic, environmental, social and financial factors
(5) Stress human and interpersonnel dimensions
(6) Lead to a professional master's degree and possibly a doctorate
(7) Draw upon whatever disciplinary and professional inputs may be needed
(8) Provide for a number of basic courses taught by faculty members whose primary responsibility is to the program.

5. Course Coverage

The program in public works planning and management should enable a student to:

(1) Attain a solid grounding in public policy formation and public administration in the public works environment
(2) Achieve skill in application of analytical and evaluation techniques to public works problems and situations
(3) Develop competences in planning and management of public works programs with due regard to conditioning social, economic, financial, political and environmental factors
(4) Improve substantive knowledge and ability to apply analytical and managerial competences in a particular field or subfunction, e.g., transportation, water resources, environmental protection, solid waste management, urban planning and development, housing, electric power, traffic engineering, etc.

The dual degree options should be oriented to the application of science and technology in substantive fields of public works/environmental practice.

6. Operational requisites

Curriculum development and course design should recognize that usually the majority of students will be experienced persons engaged in in-service development. This is not only desirable but it also brings to the program competences that can greatly enrich it if the program is adapted to this factor.

7. Degree terminology

"Public works planning and management" is used generically to connote the nature of the administrative degree. If a special degree is offered by the school of public affairs/administration, this form or some other appropriate label could be used — "public works administration" or "public works and environmental administration." APWA has advocated "master of public works," the term used at Pittsburgh.

Use of the standard MPA (master of public affairs or administration) degree is acceptable, provided it applies to a specialization in public works adminstration or management. For obvious reasons, an engineering degree would not be appropriate for a planning and management program sponsored by a collaborative center. The dual degrees may be those in traditional use by schools of engineering, public health, urban planning, etc. or they may be redefined to feature the public works/environmental character of the pro-

grams. A Ph.D. or D.P.A. (public administration) focused on public works or a doctor of public works (and environmental) administration are suitable degrees for a doctoral program in public affairs/administration.

8. Faculty

The public works planning and management program requires at least one full-time academically appointed person (in addition to the head) qualified to (a) give instruction of graduate professional quality and (b) engage in action-research and advisory services. Full-time members would be supplemented by part-time appointments of practitioners from public works agencies, by joint appointments of faculty of various departments and schools, and by use of other faculty to teach particular courses (including the cross-listing of relevant courses). Members of the faculty should have an interdisciplinary orientation, be professionally educated and be capable of operational instruction and research of the character described under criteria "5."

9. Master's requirements

The minimum requirement for completion of this kind of master's degree is the equivalent of a full year (eleven months) of full-time academic study. This may consist of two traditional semesters and a summer term, three trimesters, four quarters or an aggregate of part-time and special programs equal to a calendar year.

The program may include an internship (for inexperienced persons), a research project or field work. Individuals who have already completed relevant graduate course work in public affairs or who have had beneficial experience may be granted advanced standing.

An integrated dual degree program in which the student simultaneously earns a master's in public works planning and management and a master's in engineering, environmental health, urban planning, etc., will require at least one additional term or semester.

10. Students

The school awarding the master of public works degree should have authority to set qualification standards, to recruit and to admit students. The method of assessment should take into account the practitioner character of the students. Active and sustained recruitment (working in collaboration with local APWA, ASPA and ASCE chapters, councils of government, federal executive boards, state and municipal personnel agencies, etc.) of both in-service and pre-service students is essential. While most students will hold an engineering degree, some may be physical, biological, or social scientists; urban planners and developers; or public administrators. The aim is to admit persons with solid intellectual resources, outstanding personal qualities and a high commitment to public service.

Inasmuch as full-time study with extensive group interaction and special events provides the best learning experience, concentrated effort should be devoted to recruitment of full-time students. However, many of the potential students of master's programs will be public works employees available only for part-time study. Sufficient courses to meet their needs should be offered at convenient times and places.

The minimum number of degree students to support a satisfactory master of public works program is about twelve to fifteen full-time students and

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twenty-five to thirty part-time students. Persons working for other degrees and non-degree students will increase the aggregate. This would make a total of about twenty to twenty-five full-time equivalents (FTE's). Less than this is insufficient to support an adequate curriculum. Two or three times this number is desirable.

11. Student financial assistance

Fellowships, assistantships, research stipends, work-study arrangements or other forms of financial aid are indispensable in initiating a public works educational program. No program should be launched without arrangements for financial support for several full-time students. Thus, paralleling its measures to stimulate applications, an institution must engage in vigorous promotion and negotiation to develop:

(1) A continuous flow of sponsored full-time mid-career students
(2) Agency support for part-timers
(3) Fellowships and other financial assistance for a few recent graduates (especially minority persons) and for personnel of public agencies whose employers are willing to provide leaves but unable to provide financial support.

12. Non-degree training

A public works center should support short-term courses, workshops, institutes or seminars to upgrade federal, state, local, and private public works personnel in the region. These courses complement and support the academic program and beneficially involve staff in agency relationships.

13. Research and services

The public works unit should itself or through its constituent schools:

(1) Engage in action-oriented research, surveys and advisory assistance (involving other units of the university where appropriate)
(2) Support participation in professional societies and conferences
(3) Engage in voluntary public service and events
(4) Recognize the value of public service in promotions and salary advancements

14. Facilities

Ideally the public works center should be housed with the school of public affairs/administration which awards the master's of public works planning and management degree. These quarters should be as suitable as those provided by a school of business, law, engineering or public health. Unattractive and makeshift arrangements would discredit the effort. The program requires modern seminar rooms, facilities for use of visual aids, research areas and offices in keeping with the importance of the function.

Students, faculty and officials require ready access to a working reference library featuring public works, environmental protection, urban planning and development and public administration reports, studies and documents. A laboratory and computer resources for data development, simulation exercises and instructional and research needs (including a data link to the university's computation center) should also be available. Such facilities are ordinarily found in a school of public affairs/administration.

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15. Budgetary support

A special budget allocated to the public works entity must be sufficient to support a program of the scope and quality outlined above. Around $100,000 annually is a good target. Unless there is a university commitment that progressive support will be forthcoming, no program should be started. The staff should have the opportunity to seek grant and contract funds for fellowships, teaching and research. This calls for maintenance of contacts with federal, state and local agencies, foundations, corporations, philanthropists and other potential sources of support.

16. Administrative support

It is axiomatic that a program in public works administration must draw upon and cooperate with other public service-oriented departments and schools for both instructional and research purposes. Leadership and active support by central university officers is indispensable, if continuing collaborative arrangements are to be achieved.

17. Establishing a program

Ordinarily a program which fulfills these criteria cannot be put into operation in the first year. Two or three years are usually required. However, before the program is initiated or any announcement is made, the complete plan should be developed in consultation with public works agencies, APWA and NASPAA. Encouragement or support by these two organizations is dependent upon the presentation of such a plan.

Many university efforts of this kind falter because they are launched without a definitive plan developed in consultation and approved by university authorities. Often there is too much rhetoric and too little developmental work. Planning, programming, and institution building, which form a significant element in any curriculum, are the most critical tasks in launching a center. If a university is unable to formulate and secure funding for a well-developed plan, it should elect some other optional arrangement.